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THE PHYSIOLOGIC LIFE[1]

WE know to-day many factors that injure the individual, and a few that seem to injure the race. But in our almost complete ignorance of the mechanisms of race improvement, we seem impotent on the positive side, except that by eliminating those who deviate markedly from the average we may give the latter group more elbow room. By selection and controlled breeding we seem to be able to secure a fatter hog and a faster horse. Have we thereby secured a better hog and a better horse?

Assuming that we know how to achieve fundamental race improvement, is there any agreement as to the goal? Is the super model of *homo sapiens* to be constructed on the line of a Mussolini, a Gandhi, an Einstein, a Dempsey, a Darwin or a Henry Ford? Is he to be "wet" or "dry"? Should he be white, black, yellow, brown, pink or gray? Should he be six or sixty feet tall? Should he be a more rational or a more emotional machine? Is he to be a pacifist or a man fitted to wage bigger and better wars? Are we to aim at a better coordinated society of masters and slaves or a democracy?

The present state of development of man and his fellow animals has come about through the forces of heredity and environment, practically without an iota of conscious direction based on accumulated experience. The time during which we have had even an approximate understanding of our physiological processes, and the factors that favor or impede the same, is so short that it may virtually be ignored in the total time span that man and other animals have existed upon the earth. If we knew what our forebears ate and drank (and how much); if we knew how they worked, rested, loved, we could with greater certainty put the labels "favorable" and "unfavorable" on the manner of living and on the man-made environment of to-day.

We may assume that the present man is the best possible product of past conditions. In what respects do conditions of human life to-day differ from those of yesterday, and do any of the new conditions bode ill for to-morrow?

1. Modern man cooks, preserves, sterilizes and denatures his food to a greater extent than his forebears.

2. Modern man lives under more uniform climatic

[1] Address given at the third Race Betterment Conference, Battle Creek, Michigan, January, 1928.

conditions because of clothes, houses and fire. Also, in consequence of these, he lives less in the open and farther from the sun than did the primitive man.

3. As a consequence of industrial developments and growth of cities a large proportion of men of to-day are more crowded, more subject to polluted air, polluted drinking water and industrial poisoning than our ancestors.

4. As a consequence of the growth of knowledge, particularly of chemistry and medicine, man of to-day is being subjected to a greater variety and quantity of stimulants and drugs.

5. Because of greater knowledge of nature modern man has less fear, but probably more anxiety than the man of the past.

6. The sex life of modern man seems ill-adjusted to prevailing social theory and practice. We do not know, but it seems probable, that the very ancients lived a more biological sex life.

7. In consequence of the growth of knowledge, art, industry and invention, man of to-day is probably subjected to a more continuous, if not more varied, nerve strain than in the remote past. We have accumulating evidence that excessive brain activity may interfere with some fundamental physiological processes, as a powerful gas engine may shake to pieces a less solidly built chassis.

FOODS

We may assume that our forebears (as well as all other animals in all ages) have from time to time been subjected to quantitative under-nutrition, that is, starvation. In tropical climates this is merely a question of the number of animals and quantity of available food. In temperate climates it is also a question of seasons. To be sure, many animals have become adapted in relation to the second factor, they have become accustomed to prolonged inactivity and starvation (hibernation). We have no evidence that man himself ever was a hibernating animal. But we think it is safe to assume that modern man has reached his present stage of perfection (or imperfection) through periods of quantitative under-nutrition as well as periods of gorging in the presence of plenty. There is no reason to think that our ancestors, any more than their fellow animals or modern man refrained from eating far above their actual physiological needs if plenty of food was available. It seems probable that qualitative under-nutrition, that is, diets lacking for a long time in essential salts, essential vitamins, essential proteins and in essential roughage, was probably less prevalent among our primitive ancestors, because cooking and food refining is a late acquisition. If this is correct, it follows that most of our food-deficiency diseases, excepting, of course, those that are brought on as a result of quantitative starvation, are man-made diseases. I refer to the various pathological processes induced by lack of vitamins, by lack of adequate proteins, by lack of roughage in the food and by lack of proper salts in the food. Man has brought these on himself largely through misguided esthetics and perverted taste, and by commercialism not controlled by physiologic knowledge.

We should add in all fairness that as man is now distributed on the earth various types of food preservation or sterilization is a necessity, not only preservation from season to season, but such preservation that food can be shipped long distances from one country to another where the density of population is in excess of the ability of the country to feed it. The problem of food preservation and a food purification is one of commanding importance to our race to-day, because in this respect industrial processes and dietary habits of long standing are only slowly brought under control of physiologic knowledge. We still mill our grain and feed the bran to hogs and cattle. This may help to develop super hogs and super cattle, but it is no aid to the physiologic life of man.

On the basis of our present knowledge of the physiology of man, the old question of vegetarianism *vs.* foods of animal origin has little or no merit in fact. There is no doubt that the individual man can injure himself temporarily and possibly permanently by the overeating of meat. Possibly our very remote ancestors were strictly herbivorous; the earliest animals must, perforce, until they turned cannibals, have been herbivorous, but man, as we know him to-day, can use food of animal origin with impunity and physiological profit. We should say that the more nearly omnivorous the human individual is, the more certain he is to avoid diseases due to faulty diets. Indeed, it would be more conducive to the physiologic life if we set about, through education, to remove the present human prejudices against certain species of animals as sources of food than to keep alive the "religious" superstitions that some or all foods of animal origin are taboo. I refer to such notions as "clean" and "unclean" animals handed down to us by the laws of Moses, the abstaining from meat on the basis of "transmigration of souls," the eschewing of certain animals as food because they look repulsive or disagreeable or because they are friends of man. Almost any species of animals, by proper training, can be made the apparent friend of man. If the present rapid increase in population continues we should contribute more to the physiologic life by teaching universal omnivorousness than by clinging to ideas

handed down to us by the ignorant past or dictated by the whims of imagination. The eel is not a poisonous article of food merely because it has the body form of a snake; the snake itself is not bad eating despite the alleged rôle of the snake in the "fall of man." By omnivorous I do not mean food of animal origin alone; I mean also a much greater extension of the use of the vegetable kingdom. Sailors learned to cure scurvy by a decoction of pine needles when nothing else was at hand. It is hinted that the eating of grass by Nebuchadnezzar was a "curse of God," while, as a matter of fact, it was part of wisdom.

With every new advance in the knowledge of the specific rôle or of specific needs for food elements, there blossom forth commercial enterprises whose advertising tends to confuse the public mind. Thus, we are urged to buy vitamin concentrates over the drug counter instead of natural foods at the grocery store. We eliminate roughage from the food and try to palliate constipation by mineral oils. We are made to believe by persistent advertising that we are on the brink of an abyss unless cod-liver oil, yeast or nuxated iron is ingested daily. We are taught to identify whiteness or absence of color in many foods with purity and, by inference, wholesomeness of such food articles.

The problem of obesity in the human individual is largely a question of overeating and under-exercising. To what extent overeating may contribute to race deterioration it is difficult to say, because that implies injury to the germ plasm; the possible injury to the individual is of little racial significance.

WORK

If we survey the animal kingdom as it exists today it seems, by and large, that except for the play of the young, the only exercise taken is that rendered necessary for the securing of food, the propagation of the species and escape from pain. Of course, in all animals living in temperate or colder climates, cold itself, for the warm-blooded animal like man, is efficient physical exercise. But when not driven by hunger or sex most animals (including man) are lazy. It is highly probable therefore that man has reached his present state of development on the basis of exercise largely determined by physical necessities. This rule still applies to the majority of humans the world over. The majority have no accumulated food reserves. Most of us have to do physical work every day for a living. The problem of race deterioration from physical inactivity applies therefore only to a small portion of society, the so-called well-to-do, who can through their wealth command the satisfaction of most needs without individual physical exertion. There is no question in the case of many of the body organs that a certain amount of atrophy and deterioration follows in the wake of disuse, and consequently, activity, however caused, is within limits beneficial. But does such physical inactivity cause deterioration of the germ-plasm? And at what point does excess of physical work lead to germ-plasm degeneration? Biology has as yet no clear answer to these questions.

HOUSING

The only abodes of our most ancient forebears that have survived to historic time are natural caves, but even assuming that humans were not very numerous in those days, I doubt whether there were caves enough to house them all. And it is not unlikely that our forebears lived in trees for some time before they stepped down into caves. The caves of our forebears were probably no healthier than modern apartments. Some type of hole in the ground, or on the ground, seems necessary as a protection against the rigors of climate. But modern industry demands and creates these holes in ever-increasing numbers of horizontal layers. The influence of city life on the race is a large problem, without an answer as yet. It is a question not only of sunlight and pure air, but of crowding, of infections, of immunity, noise, glare, mimicry and exhaustion. A place under the ultraviolet lamp may be a safe substitute for the place in the sun. Many species of animals have not only survived but apparently made continued progress in almost total absence of sunlight. I do not refer to animals living permanently in caves, because in many of these we see some signs of degeneration, probably because the cave of life has been adopted too suddenly, but I refer to animals that during the day live in caves or holes in the ground and hunt for their food during the night. Pollution of air and water by modern cities and modern industry is on the increase, and the probable danger from these conditions seems only partly appreciated by society. Formerly, lead poisoning was largely confined to workers in lead industries. Now lead is blown into the air from the exhaust of nearly every automobile. Lead and arsenic are taken into our system with the apple and the pear. We may not inhale enough lead in our breathing or consume enough lead and arsenic in our fruit to produce acute poisoning and tissue injury, but who is there to say that this slow assimilation of metallic poisons brought about by modern industry is without danger and ultimate injury? The only factor of safety that I can see in this situation is the phenomenon of tolerance, that is, the capacity of the living organism, if it is not seriously wrecked by the poisons, to so adjust the internal processes as

to render the poisons less and less injurious. Tolerance means physiologic compromise, but such continued existence does not necessarily mean the higher life. Continued increase of population means increased growth of cities, increased industrial concentration and increased industrial poisoning, despite all measures to eliminate the latter.

The Sex Life

One of the fundamental physiologic processes that at present seems to be out of adjustment to a greater extent in man than in our fellow animals is sex life. We are not agreed as to what is the normal sex life of modern man, but ethical leaders in all races have on the whole tended to the view that sex activity should and can be repressed or consciously controlled by the individual or society to a greater extent than the urge of hunger and thirst or the call for evacuation of the bowels. In many if not most animals the essential sex urge is seasonal and closely associated with reproduction, and, as a rule, the reproductive processes in animals start with sexual maturity and continue throughout the sex life of the individual. In most parts of the world human society is now so organized and human habits fixed in such a way that approved sexual intercourse can not start with sexual maturity in our children. This means a long period of sex repression, "illegitimate" sexual intercourse, or perverted sex practices. It is held by many, though in most cases physiologically unproved, that these three sequelae of our modern social orders as related to sex life are injurious to body and brain. The physiologist may view the mental gymnastics of the Freudians with wonder, but he is not in position to state that the present social practices as to sex are the best possible for the present or future of the race. The physiologist is puzzled by the evidence in modern man of a sex drive in excess of the need of reproduction. He is aware of the speculation that the sex drive means more than reproduction, that it is the basis of all progress in inventions, in art, in warfare, in practically everything in which modern man seems to have exceeded the ancients. If this is the case, the physiologist should not concern himself with the means of controlling or delaying the sex urge. The solution is birth control. The greater continuity and persistence of the sex urge in man than in most of the other animals may be related to the greater brain development (memory, imagination). If this is correct we have here an instance of uncorrelated development, that is, development of one organ or process leading to discoordination or injury of another.

Stimulants and Narcotics

The indulgence in narcotics and stimulants antedates chemical knowledge, but chemistry and commerce have greatly enlarged the field. We not only isolate and concentrate new drugs from plant and animal tissues, but almost every day records the synthesis of new drugs in the laboratory. Individual and organized greed extends the facilities for drug addiction.

Do not expect me to say anything new and true on the alcohol question as related to race betterment. People have imbibed alcohol in the past, have lived and reproduced. It is not difficult to prove the deterioration of the individual, and in some cases the offspring, by excessive alcoholic indulgence. Man appears, by and large, to be the only animal with the alcohol habit. All human races can become alcohol addicts unless checked by ethical considerations. "Tolerance" to alcohol has not yet been acquired by the race as a whole. Alcohol may be indifferent in race improvement, but if the issue is forced to-day, the physiologists must vote against alcohol on the basis of probable injury.

No word can be said in defense of the other narcotic drugs. Their influence on normal life seems to be uniformly injurious, except possibly in the direction of protection of the brain against the overstimulation and over-fatigue of the modern man-made environment. There are instances from experimental laboratories of morphine, barbital or ether protecting the brain or parts of the brain from fatal effects of such stimulation or from otherwise fatal effects of acute poisoning.

I know of no evidence that the alkaloids of coffee, tea and tobacco improve the individual or the species. Whether they are factors leading to race deterioration is an open question. Many people believe that this is the case, but belief is not knowledge. Some weight should be given to the fact that during the period that many humans have indulged in these substances, man has made rapid progress in externals, but this progress has probably been made despite this indulgence rather than because of it.

Modern chemistry has opened up another avenue of poisoning the human system through the field of food preservatives and food substitutes. We have the problem of the harmfulness or the harmlessness of the various baking powders, of benzoic acid as a permissible food preservative, of saccharine as a substitute for sugar, etc. Many of the experiments purporting to prove the permissibility or harmlessness of the substance or preservative, even those carried out by competent scientists, seem to me wholly inadequate. I have in mind, as an example, the experiments and finding of the Remsen Consulting Board, on the question of saccharine in foods. Under the direction of this board, composed of leading biochemists and chemists, varying quantities of saccharine were fed to

a small number of healthy young men, daily, for periods up to nine months. The board concluded that the daily ingestion of this food substitute below a certain quantity (.3 gram per day) is without injurious effects; above this saccharine produces injury. This conclusion became guide to federal legislation and regulation. Was the above conclusion warranted by the experiments performed? We think not. All the experiments proved was that the substance (saccharine) when taken by healthy young men over this period did not produce any injury that the commission could detect by the tests used. Society is composed of individuals other than healthy young men, and nine months is a short period in the span of human life. There are many deviations of physiological processes that can not be detected by body weight, food intake, or the chemical examination of the urine. Most of the organs in the body can be injured a great deal before we become actually sick. It would seem a safer principle for governments and society to insist that the burden of proof of harmlessness falls on the manufacturer or the introducer of the new food substitutes rather than on society, and the test of the harmfulness or harmlessness should involve all physiological processes of man.

The Invisible Enemies

There are people who believe that the future progress of the human race will be measured by our success in eradicating infectious organisms (preventive medicine), and in such complete understanding of physiological processes as to enable us to control the processes of immunity. Paleopathology furnishes no conclusive evidence that races or species now extinct were slain by infectious diseases. Far be it from me, as a worker in one corner of the medical garden, to minimize the importance of medical science both in the preservative and in the curative aspect of race betterment. But I can not see how mere prolongation of the individual life span or mere multiplication of human individuals will enhance human evolution. Indeed the reverse argument is not easily met, namely, that medical science to-day helps to deteriorate the race by helping the biologically weak to survive and reproduce. Knowledge of the processes of immunity sufficient to enable us to augment this factor in the individual, apart from what we already know in a general way of hereditary strain, improved nutrition and hygienic surroundings, seems far afield; but, again, it may come faster than the most optimistic prediction.

Eradication of infectious organisms or complete control of the individual infection by chemotherapy seems Utopian. The scientist who ventures to prophesy to-day has a good prospect of being shown up a fool to-morrow. But it seems likely that the human race will survive (and in fair if not improved shape) all now known infectious organisms, not by the process of eradication or scientifically controlled immunity, but by the process of tolerance and symbiosis. Whether this prospect is cheerful or abhorrent depends on whether the symbiosis involves the loss of any essential element of further evolution of our species.

Climate and Human Evolution

Some one has remarked that our planet is better fitted for pisciculture than for human culture, since water covers the greater area of the earth's surface. The cradle (or cradles) of the human race is not yet located, hence the climatic conditions of early human evolution is one of the many unknowns in the process. But to-day, man (as well as the rat, the body louse and the English sparrow) covers practically all of the land, so that we have all the possibilities for favorable and unfavorable evolution so far as evolution is conditioned by climatic factors alone. This gigantic experiment in human ecology is, however, becoming increasingly complicated by man-made modifications of his environment. We have scarcely made a beginning in the study of the influence of climate on human physiology. The sporadic appearance of the externals of human culture in diverse places of the earth in the past is probably not primarily a matter of climate. Heat and humidity can be depressing on some physiologic processes. Because of the factor of basal metabolic rate man is less able to adjust to the extremes of heat and humidity than to extreme cold. We know some of the favorable effects of sunlight (*e.g.*, bone growth, killing of bacteria, etc.); we have hints of unfavorable effects on the blood, the blood pressure and the retina, and the skin. The latter may not be fundamental and there is no evidence that the germ plasm is unfavorably influenced.

We know something of the favorable and unfavorable influence of diets, work, behavior, natural and man-made environments, poisons, etc., on the physiologic processes of the individual. But this is merely limiting or permitting full development of individual growth and functions. Unless these factors modify the germ plasm (rapidly or slowly) they are not significant in relation to race betterment. The only clear instances we have of rapid modification of the germ plasm by experimental (drugs) or environmental means seem to be injurious or destructive. Man to-day is like a curious and clumsy and very ignorant child tinkering with the watch; will he to-morrow con-

trive a superior mechanism? The lesson for the present seems clear: *The germ plasm can be injured; some phases of the present man-made environment seem to enhance such injury.* Are the ablest the strongest, the wisest men merely grave-diggers in disguise? Is it possible to detect the factors and abort the danger so that man himself may not deflect or impede the river of life?

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A REVISION OF THE FUNDAMENTAL LAW OF HABIT FORMATION[1]

THE principles of learning, or habit formation, as they are taught by contemporary psychologists, include as fundamental the principles of recency and frequency. It is true that there are considerable differences in the relative emphasis placed on these principles by different authors—few, for example, going as far as Watson and the present writer have gone in the past in the ascription of importance to frequency. Nevertheless, the importance of these factors has been emphasized by almost all contemporary psychologists (with the possible exception of Carr), who seem to have assumed that they are of some positive value in the fixation of a response into a habit.

Behind these principles, however, there is a more fundamental assumption, which was sharply indicated by William James, but which has seemed too obvious to need statement by those of us who have nevertheless continued in the Jimmian philosophy. This assumption is as follows: *A response* (that is, even a single response) *to a given stimulus pattern definitely increases the probability that on the reoccurrence of the same, or substantially the same, stimulus pattern, the same, or approximately the same, response will occur.* This principle I shall call the *alpha-postulate* of learning.

That this principle underlies the "law of frequency" is obvious, for if one response had no positive effect, then the summation of an indefinite number would have no effect, the sum of zeros being zero. The pictorial statement of this assumption is to be found in the formulations of the old "brain path" superstition, with its analogies to the flow of water eroding a channel, the fold in a coat sleeve, etc.

It has not been denied by any one, so far as I know, that the positive effects of repetition might not be neutralized by other factors, nor that certain other factors may be, in some cases at least, more potent positively. But running through all our disquisitions on learning has been the implication that repetition itself, aside from other factors, has a positive effect; and in our practical work with adjustment cases, this implication has always been respected.

For nearly twenty-five years the present writer has been teaching, explicitly and implicitly, this orthodox doctrine, and attempting to fit the facts somehow to the theory. Even the contradictory results of the Pavlovians failed to shake his faith, because obviously (at least, so far as references in English indicate) neither Pavloff nor his students have ever performed the critical experiment of feeding the dog by stomach injection, without odor or other "conditioning" stimulation, during the period during which the newly formed associative response ("conditioned response") is being tested. The Russian work on this particular point (of the effect of repetition) is therefore beside the mark, and did not even suggest to the present writer a revision of the laws of learning. Psychologists, in fact, have long been acquainted with cases in which habit-tendency disappears in spite of repetition of the stimulus, and this phenomenon has offered no difficulties to the orthodox theory.

The cumulative effect of the difficulty of fitting facts to the theory, however, has, although no longer ago than last summer, suggested that it would be much simpler to fit the theory to the facts. It has seemed well, therefore, to question the fundamental assumption on which we have proceeded.

If we no longer take the assumption of the positive effect of response as a divinely revealed truth, but as a mere postulate, it is at once seen that there are two other postulates possible. One of these, the *beta-postulate,* as I shall call it, is that response, in itself, has *no* effect on the future probability of the same stimulus pattern producing the same response; the other, the *gamma-postulate,* is that response *decreases* the probability. Although the latter of these postulates is more consonant with our present-day neurological theories, and, as I shall show later, has interesting applications to a difficult psychological problem, a certain conservatism, which I think is intelligent, leads me to consider seriously the beta-postulate first.

If "repetition" has in itself no effect, but is important merely in that through it certain positive factors have their chance to operate, then it at once becomes a live possibility that negative factors also may be allowed to operate through repetition. Thus would be explained the apparent "neutralizing" of the effects of repetition, not as actual neutralization in this sense, but as either the operation of negative factors in the absence of positive, or the prevalence of the negative over the positive.[2]

[1] Read before the Section on Psychology, the American Association for the Advancement of Science, Nashville, December 27, 1928.

[2] I am informed by Dr. T. V. Moore that Thomas Aquinas enunciated this doctrine. I should certainly feel honored if I am in any wise treading in the footsteps of the *Doctor Universalis.*

The deductions from our postulate are still more interesting. If the negative factors, those which decrease the probability of the recurrence of the response, can be discovered, repetition may be used practically for the abolition of a habit already formed. This is, I think, a new idea, and worth trying, even aside from the possible light the results may throw on our postulate. Can we, for example, cure stammering, through causing the patient to stammer voluntarily in as nearly as possible the same way in which he ordinarily stammers? Can we abolish tics through causing the tic to occur? If so, we should have a method of "catharsis" of enormous value, and the method should be applicable to a host of minor defects of response and conduct, as well as to such major troubles.

The first question which arises is as to the negative factors which may be called into operation. Consideration of the experimental techniques such as dart-throwing and other practice work which had led to my scepticism concerning the orthodox postulate brought out conventional factors of *"interest," "anticipatory idea,"*[3] and *satisfaction.* It seemed useful, therefore, to proceed tentatively on the assumption that the satisfaction of abolishing an annoying process (and perhaps the futuric interest and expectation of such satisfaction), together with the expectation of attaining an end definitely thought of (anticipatory idea), and, where possible, the desire of this end, would be useful negating factors, and to see what could be done with the aid of these.

The first opportunity which occurred for the testing of this method lay in an idiosyncrasy of my own in typewriting. For some years I have been annoyed, when typing rapidly, by an occasional transposition of the letters of a word, the word "the" being especially troublesome, so that in reading over a manuscript of my own typing I would sometimes find two, three or more of these transpositions into "hte." Several times I have attempted, by careful practice, to train myself out of the habit. The fact that in the majority of cases I actually wrote "the," exchanging it for "hte" only in a minority of cases and when typing rapidly, in itself indicates the futility of increased repetition of the "right" spelling.

On the basis of the neutral postulate, I now proceeded to try the typing of "hte" voluntarily, as a means of destroying it. I set to work deliberately and wrote about a half page, single spaced, of the "hte" combination, with the futuric thought that this was a "word" that I would *not* write in the future (unless deliberately and voluntarily). Somewhat over a week later, I followed this with a second "practice period," writing less than a third of a page. This was over three months ago. Since that time I have typed many pages, some rapidly, but have not found on reading them over a single case of "hte"! This may sound too easy to be true, but as a matter of fact a long-standing and troublesome habit has disappeared.

Having just changed from driving a Ford to operating a gear-shift car, certain minor vices of technique, such as a tendency to step on the accelerator, when meaning to apply the brake, manifested themselves. The application of the catharsis method seems to have overcome these faults very quickly. Such trials on myself have, of course, no scientific value, but served merely as encouragement in the application to more critical cases.

The application of the method to speech defects offers an interesting field. In the case of stammerers, the vital point of proceeding here is to study the specific type of stammering and then induce the patient to reproduce voluntarily his characteristic verbal performance, criticizing and assisting him until his voluntary stammering is as nearly as possible like his involuntary. From that point on, the technique is complicated, and we do not expect to have it perfected until many cases have been experimentally subjected to it. In the meantime, the results even with the crude preliminary method are very favorable.

Ties offer another interesting field of application, where methods are being developed. Thumb-sucking and similar wrong habits of two or three year old children have been treated with results that apparently show that the method is useful at these ages, where I feared it could not be applied. There are many other directions of application, such as bed-wetting and masturbation, where the method can probably be applied as soon as the technique is better developed. It has already been applied to a case of homosexuality, with astonishingly rapid results. It is hard to set the limits of possible application, and from present indications a vast number of hitherto insoluble problems may be solved in this way.

So far, in all applications, we have assumed the importance of anticipatory ideas and desire as elementary factors. The patients are (1) selected on the basis of their desiring, for one reason or another, to cure the habit, and (2) are carefully instructed that the voluntary performance, under the experimenter's control, is something which will assist in the abolition of the behavior at other times.

One of the most important applications of the new postulate, and one of its most interesting points theoretically, is in the explanation of dreams. So

[3] I can't well use the term "purpose" in this connection, because "purpose" has been given an anti-mechanistic, *i.e.*, mystical, interpretation, and I wish to discuss and investigate this problem on the plane of strict mechanism.

far, dreaming has been assumed to be a pathological function, although of minor importance in most cases, or else has been assumed to be a mere by-product of mental life, in itself of no value. It has long seemed to me, however, that the development and retention of function, generation after generation, indicates a strong probability that the function is not pathological, but has some important value for practical life. The difficulty has been in discovering the practical value of dreams.

As soon as we reject the old alpha-postulate of learning, however, and assume either the beta-postulate or the gamma-postulate, the function of the dream becomes apparent. The dream is a process of eliminating, or "forgetting," details of mental performance which it is useful to take out of the habit-systems, either because of their irrelevancy, or perhaps because of their interference with orderly mental life. The importance of forgetting as compared with remembering, or, in a more comprehensive way, of elimination of habit tendencies, as compared with their fixation and retention, has long been recognized. The greater part of daily experience must be forgotten, and removed from the danger of associative recall, if the remaining small parts of the experiences are to be effectively utilized. The greater part of our daily activities of all sorts, also, must be prevented from becoming response habits. Ideational retention, that is, the tendency to reproduce in thought the contents of preceding perception and thoughts, is of especial importance. If one should retain, subject to complete recall, all the experiences of a single day, his mental efficiency would be sadly reduced thereby. One aspect of this incompetence is nicely portrayed by James in his account of "total redintegration," characteristic of many women and some men.

Many experiences, we may well assume (if we reject the alpha-postulate), leave no tendencies to recall, or towards partial recall which would interfere with other processes. Others, however, because of the operation of favorable fixation factors, tend to persist, and require some help in their elimination.

The known peculiarities of dreams fit in very well with this hypothesis, and with general suspicions regarding important fixation-factors. Dreams are most characteristically about trivial and unimportant matters—just the sort of things which need to be eliminated. In other cases, they are reproductions of emotionally stressed factors of working life, which especially need elimination. In many of these cases, it is obvious that an unsuccessful effort is being made to eliminate, and this effort may be repeated in many successive dreams. It is to be expected, too, that not only will repetition fail to eliminate in some cases, but that even the repetitive process will itself partially fail, and the dream be composed of factors associated with the factors which ought to be eliminated, rather than of those factors themselves. The importance of the problem of *improving* dreams, of making dreams more effective and of the *production* of dreams to assist in eliminating disturbing factors of daily life is at once seen. Much research needs to be done here. As I have earlier pointed out, dreams consist mainly of, or center about, experiences in which a futuric factor has been a feature. That is to say, anticipatory ideas, centered often in hopes, fears, expectations and desires, are the chief causal factors in dreams. This agrees with the supposition, made on other grounds, that an important fixation factor in habit formation is expectation, or anticipatory ideas of the result to be obtained.

In considering the dream situation, one might perhaps incline to the adoption of the gamma-hypothesis instead of the beta-hypothesis, were it not for the consideration that even here it is not, as yet, necessary to make the assumption that repetition has, in itself, an eliminative effect. All we need to assume, for the present, is that conditions are favorable, during sleep, for the operation of eliminative factors, whatever these may be. If, later, we have to assume that repetition itself is the factor, that is a matter to be faced then. For the present, we may follow the principle of parsimony, and make the simpler assumption; namely, the beta-postulate.

The same consideration appears in the problem of the ancient confessional as utilized in the "psycho-analytic" method. The expression of troublesome thoughts need not be assumed to be cathartic in itself; the conditions of the confessional may introduce eliminative factors which are not operative in other phases of the patient's repetitions. Many other factors need to be investigated in these cases, including the relation of speech formulation in processes which have previously been internal (cerebro-cerebellar, according to my own hypotheses).

In conclusion, it may be pointed out that the successful eventuation of methods of therapy deduced from the beta-postulate do not prove the final truth of the postulate. But its value is certainly demonstrated by the practical benefits derived from these deductions.

KNIGHT DUNLAP

JOHNS HOPKINS UNIVERSITY

HENRI BOSMANS

WITH the death of Henri Bosmans, of the Jesuit College of Saint-Michel, at Brussels, there passed away one of the most active men of the present century in the field of the history of mathematics. Bosmans died on February 3 of the present year, at the

advanced age of seventy-six and in the fifty-seventh year of his religious life as a Jesuit. His first historical paper published in 1900 related to Snell's measurement of the earth's meridian; his last contribution which has reached us is a Preface to Gillain's Arithmétique Egyptienne, dated October, 1927. Between 1900 and 1928, Bosmans issued a steady flow of papers relating mainly to fifteenth, sixteenth and seventeenth century mathematicians, most of whose works are not generally accessible. He remained active to the last, notwithstanding his partial blindness in later years. A noteworthy incident was his borrowing from the Louvain Library one of the very few copies still extant of Simon Stevin's book, Le Thiende, on decimal fractions, and thereby saving it from destruction, for while the book was in his possession the Louvain Library was burned. Bosmans was of a kindly disposition. Some years ago, when the present writer happened to state in a letter that he was working on the evolution of the theory of limits, and ought to have access to Gregory St. Vincent's geometry, Bosmans had passages in that work photographed which he sent with his compliments. His keenness of mind as well as his sympathetic and appreciative nature are seen in his numerous book reviews.

FLORIAN CAJORI

UNIVERSITY OF CALIFORNIA

SCIENTIFIC EVENTS

INTERNATIONAL SOCIETY FOR THE EXPLORATION OF THE ARCTIC REGIONS BY MEANS OF THE AIRSHIP (AEROARCTIC)

MORE than three years ago the society under consideration was organized in Germany. It attracted a number of people of different countries interested in the investigation of the Arctic regions, and, so far as Europe and Asia are concerned, it has a good representation in nearly all the countries of the Old World. The society was well represented at its first international meeting, which was held in Berlin from November 9 to 13, 1926. The second meeting will be held in June of this year at Leningrad, U. S. S. R. Beginning in 1928 the society will publish a quarterly journal, *Arctis*, under the editorship of Dr. Fr. Nansen, president. Among the collaborators of the journal in the United States are Dr. L. A. Bauer, director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, V. Stefansson, and the writer. Besides Dr. Nansen, the membership list of the society contains a number of people well-known in connection with the exploration of Arctic regions in their respective countries as well as internationally.

The epic heroic period of Arctic travels might be considered finished with the last memorable Peary expedition, but Arctic regions are still very little known and much less explored and investigated. The new international society attacks the problem from different points of view. Being ready to send Arctic expeditions in an airship and already preparing them, the society puts the greatest weight on the conquering of Arctic regions by means of a regular siege, which will be possible only if all the countries bordering the Arctic will cooperate in carrying on systematic work within their national borders. The program of the society can not be accomplished by any one country alone, but is an international enterprise which has to be worked out in national frames.

The United States and Canada, the countries of the New World having Arctic possessions, have not been represented previously in this international organization. However, the Canadian branch is now being organized, and the American branch for the United States has come into life during this year. The officers of the American branch are: *President,* Dr. L. A. Bauer; *vice-president,* Dr. J. A. Fleming, of the Carnegie Institution of Washington; *secretary,* I. P. Tolmachoff, of the Carnegie Museum of Pittsburgh. Any information concerning the new organization can be obtained from the secretary.

Dr. Fr. Nansen in May of this year is expected in this country to attend the meeting of the American Peace Society at Cleveland, Ohio, and it may be also possible for him to give some lectures on the activity of the International Society for the Exploration of the Arctic regions, its achievements and the program of the future work.

I. TOLMACHOFF

CARNEGIE MUSEUM,
PITTSBURGH, PA.

THE REORGANIZATION OF THE POST-GRADUATE MEDICAL SCHOOL AND HOSPITAL

THE appointment of Dr. Edward Hicks Hume, former president of the Colleges of Yale-in-China and for many years identified with national and international hospital and medical educational work, director of the New York Post-Graduate Medical School and Hospital, recently recorded in SCIENCE, marks a change in the policies of the institution. It follows a survey made of the personnel and resources of the institution, which Dr. Hume has been working on since May, 1927, which proposes certain administrative and teaching rearrangements, and makes recommendations regarding a new building program and better integration with the nation-wide plans for graduate medical teaching. Under the new régime, responsibility will

be centralized, so that the various departments of the institution, as well as the three officers directly concerned with administration, namely, the dean of the medical school, the superintendent of the hospital and the principal of the school of nursing, will be responsible to the board of directors through the newly appointed executive officer.

The New York Post-Graduate Medical School and Hospital, founded by Dr. D. B. St. John Roosa in 1882, was incorporated on May 25, 1886, the object of the incorporation being the establishment of a school for the further instruction of persons already possessing the degree of doctor in medicine, and a hospital for the treatment of diseased and injured persons.

During the 42 years since its incorporation, over 25,000 physicians have matriculated at the medical school, coming from every state in the union and from many foreign countries to take graduate courses here.

The directors of the institution, appreciating the need of a new program adequate to the demands of advancing medical practice, have determined to build up for the institution such a program of medical opportunity in teaching and research, and such a financial foundation as will enable it more adequately to serve the field. In this connection it is significant that the New York Academy of Medicine has just completed a series of studies on the past, present and future of graduate medicine in the vicinity of New York. The study on the future of graduate medicine was prepared by a member of the staff of the New York Post-Graduate Medical School and lays chief emphasis on the fact that graduate medical teaching, like undergraduate teaching, is a part of the national health service.

THE ST. LOUIS MEETING OF THE AMERICAN CHEMICAL SOCIETY

A SYMPOSIUM on atomic structure and valence has been arranged in connection with the seventy-fifth meeting of the American Chemical Society which meets in St. Louis, from April 16 to 19. The underlying purpose of the symposium, according to a statement made by Professor George L. Clark, of the University of Illinois, chairman of the division of physical and inorganic chemistry, is to acquaint physicists and chemists with each other's points of view and each other's demands which must be satisfied by any comprehensive theory of atomic structure in the effort to arrive at some common basis of understanding.

Speakers will include: Professor M. S. Kharasch, University of Maryland; Professor William D. Harkins, University of Chicago; Professor Samuel C. Lind, University of Minnesota; Professor C. E. M. Jauncey, Washington University, St. Louis; Karl K. Darrow, Bell Telephone Company; Professor W. H. Rodebush, University of Illinois; Professor J. H. VanVleck, University of Minnesota; Professor W. A. Noyes, University of Illinois; Professor H. Shipley Fry, University of Cincinnati; Professor Donald H. Andrews, the Johns Hopkins University; Victor Coffman, E. I. duPont de Nemours and Company.

All divisions of the society except the colloid, fertilizer, and leather and gelatin chemistry divisions will meet at St. Louis. A preliminary report of the section programs was printed in SCIENCE for March 2, page 235.

Following the registration of delegates at the Hotel Chase, the opening event will be a meeting at 2:00 p. m., on Monday, April 16, of the society's Council, presided over by the president of the society, Dr. S. W. Parr, professor emeritus of industrial chemistry in the University of Illinois.

G. S. Robins, of the G. S. Robins and Company, 316 South Commercial Street, St. Louis, has been appointed chairman of the executive committee in charge of arrangements for the convention. Other St. Louis committee chairmen have been named as follows: *Finance,* H. A. Carlton, Mallinckrodt Chemical Works; *divisional meetings,* L. A. Watt, Monsanto Chemical Works; *hotel arrangements,* Eugene S. Weil, G. S. Robins and Company; *registration,* T. R. Ball, Washington University; *transportation and plant visits,* J. R. Hoff, Anheuser-Busch; *entertainment,* Ralph R. Matthews, Roxana Petroleum Company; *ladies' entertainment,* Mrs. R. R. Matthews; *speakers' committee,* F. W. Russe, Mallinckrodt Chemical Works; *program,* A. F. Schlichting, St. Louis College of Pharmacy; *publicity,* Chas. W. Rodewald, Washington University.

THE MILTON RESEARCH AWARDS OF HARVARD UNIVERSITY

ANNOUNCEMENT is made of thirty-seven awards to teachers in Harvard University, in accordance with the provisions of the Milton Fund for Research. This fund, which Harvard received in 1924, yields about $50,000 a year.

After the death of his wife the bulk of the estate of the late William F. Milton, '58, was to go to Harvard University for the building of a university library, or, if the university had a suitable library building, to defray the expenses of any special investigation of a medical, geographical, historical or scientific nature. It was further stated that such investigation should be "in the interests of, or for promoting the physical and material welfare and prosperity of the human race, or to assist in the discovery and perfecting of any special means of alleviating or curing

human disease, or to investigate and determine the value or importance of any discovery or invention, or any other special or temporary object of the nature above stated."

A committee was appointed, consisting of Mr. Frank B. Jewett, electrical engineer of New York, *chairman;* Professor Edwin F. Gay, of Harvard's Economics Department, and Dr. W. J. V. Osterhout, botanist of the Rockefeller Foundation; to advise the president and fellows of Harvard College in making a selection among the investigations proposed by any member of the instructing, scientific or administrative staff of the university. Requests for aid in such research were received by the committee this year up to January 10.

The grants from the Milton Fund for next year include the following:

Thomas Barbour, director of the University Museum, and Dr. Afranio Do Amaral, lecturer on ophiology, to enable them to collect neotropical snake venom for use in experimentation concerning the nature of snake venom and in preparing the curative antivenin.

Percy W. Bridgman, Hollis professor of mathematics and natural philosophy, to pay for the salaries of assistants and the purchase of apparatus to continue his work on high pressure studies and on an investigation on the properties of single crystals.

Edward S. Castle, assistant in physiology, to pay for the services of a technician in constructing apparatus for the study of the growth of plants in relation to light and temperature.

William J. Crozier, professor of general physiology, for the study of the nature of central nervous processes.

Walter F. Dearborn, professor of education, for the study of the mental and physical development of school children.

William Duane, professor of biophysics, for research in X-radiation.

Robert Emerson, research fellow in general physiology, for the services of a technician to set up and calibrate precision apparatus to study the formation of chlorophyll and development of its photosynthetic activity.

George S. Forbes, professor of chemistry, for chemicals, supplies and apparatus to be used in an investigation of conditions for electrochemical equilibrium.

Worthington C. Ford, lecturer on historical manuscripts, to complete his research in the sources of American history.

Charles Hartshorne, instructor in philosophy, to complete the preparation for publication of five volumes of the Charles S. Peirce manuscripts on philosophy.

Leigh Hoadley, assistant professor of zoology, for supplies, apparatus, expenses, etc., for an assistant in an investigation of the embryonic segregation preceding primitive streak formation in the vertebrate embryo.

Hudson Hoagland, research fellow in general physiology, for the services of an assistant to examine the underlying mechanism of tonic immobility in vertebrates.

Earnest A. Hooton, associate professor of anthropology, to continue his study of race and nationality in their relation to crime in the United States.

Grinnell Jones, associate professor of chemistry, for chemicals and apparatus, etc., in an investigation of properties of solutions of electrolytes.

Edwin C. Kemble, associate professor of physics, for the purchase of a Kipp thermo-relay amplifier and galvanometer for use in determining infra-red absorption spectra of gases.

Arthur B. Lamb, Sheldon Emory professor of organic chemistry and director of the chemical laboratory, to continue research on crystalline adsorbents.

Albert E. Navez, lecturer on physiology, for the services of an assistant to build apparatus and make experimental observations in connection with a research of geotropism in plants.

Ralph B. Perry, professor of philosophy, to prepare a volume on William James, philosopher and psychologist, from his unpublished correspondence, lecture notes, etc., in the Widener Library.

Harlow Shapley, Paine professor of practical astronomy and director of the Harvard College Observatory, to continue his research on variable stars and the dimensions of the Galaxy.

Theodore J. B. Stier, assistant in the division of biology, for the part-time services of an assistant to construct apparatus to be used in an investigation of the effects of temperature on the spontaneous activity of mice.

Robert DeC. Ward, professor of climatology, to study climatology of North America and of the West Indies for inclusion in a volume on the world's climates edited by Professor W. Köppen.

Jeffries Wyman, Jr., instructor in zoology, for expense of apparatus and materials for a study of the physical chemistry of the proteins.

SCIENTIFIC NOTES AND NEWS

THEODORE WILLIAM RICHARDS, professor of chemistry at Harvard University since 1894, director of the Gibbs Memorial Laboratory since 1912, died on April 2, at the age of sixty years.

THE sixty-fourth annual meeting of the National Academy of Sciences will be held in its building in Washington, D. C., on April 23, 24 and 25.

THE annual meeting of the American Philosophical Society will be held in the hall of the society at Independence Square, Philadelphia, on April 19, 20 and 21, under the presidency of Dr. Francis X. Dercum.

THE regular spring meeting of the executive committee of the American Association for the Advancement of Science will be held in Washington on Sunday, April 22. Matters to be considered by the committee should be in the hands of the permanent secretary a few days before the meeting.

THE coinage of a medal commemorating the achievements of Thomas A. Edison was approved on March 29 by the house coinage committee in reporting a bill by Representative Perkins. An appropriation of $1,000 would be made to enable the secretary of the treasury to prepare a suitable medal.

DR. ELIHU THOMSON, consulting engineer for the General Electric Company at its Lynn works, celebrated his seventy-fifth birthday on March 29. On that date a special resolution in honor of Dr. Thomson was passed by the executive committee of the National Electric Light Association.

THE Halley lecture at Oxford University will be delivered on June 18 by Dr. Harlow Shapley, director of the Harvard College Observatory, on "The Extent and Structure of the Milky Way."

DR. ERNEST W. BROWN, Sterling professor of mathematics at Yale University, has been elected to membership in the Royal Academy of Science of Belgium, "because of his eminent contributions to the science of mathematics."

THE cross of the Commander of the Order of the White Rose has been conferred by the Republic of Finland on Dean Albert R. Mann, of the New York State College of Agriculture, in recognition of his services in connection with the development of agricultural education. The award is the highest honorary decoration of Finland.

HENRY F. SCHMIDT, consulting engineer of the Westinghouse Electric and Manufacturing Company, has been awarded the medal of the American Society of Naval Engineers for the best article submitted during the year 1927. Mr. Schmidt, besides being awarded a gold medal, was given an honorary life membership in the society and a cash prize for his paper entitled "Some Screw Propeller Experiments with particular reference to Pumps and Blowers."

ON March 8 the University of Oxford conferred the honorary degree of M.A. on Mrs. Florence Joy Weldon, widow of the late Dr. W. F. R. Weldon, professor of zoology, who has given many valuable pictures to the university galleries.

THE German Academy of Sciences in Halle has elected Dr. M. Guggenheim, director of the F. Hoffman-La Roche and Company, Basle, to membership in recognition of his contributions to the biological sciences.

PROFESSOR JOLLY, who holds the chair of histophysiology at the Collège de France, has been elected a member of the French Academy of Medicine.

PROFESSORS NICOLAS and PIERRE DUVAL, of Paris, have been elected foreign corresponding members of the Royal Academy of Medicine of Belgium.

DR. EPHRAIM P. FELT, New York state entomologist, retired on March 31 to become adviser on shade tree and forest insect problems with the Bartlett Research Laboratories at Stamford, Conn.

DR. GEORGE R. MINOT, who was recently made director of the Thorndike memorial laboratory at the Boston City Hospital and professor of medicine at Harvard University, has been appointed consulting physician at the Peter Bent Brigham Hospital.

PROFESSOR G. S. PARKS, of the department of chemistry at Stanford University, has been elected chairman of the California section of the American Chemical Society for 1928.

DR. JOSEPH S. ILLICK, state forester of Pennsylvania, was elected chairman of the Allegheny section of the Society of American Foresters at its annual winter meeting.

AT the annual meeting of the American Heart Association, Boston, on February 6, the following officers were reelected for the ensuing year: Drs. James B. Herrick, Chicago, *president;* William H. Robey, *vice-president;* Haven Emerson, New York, *secretary,* and Paul D. White, Boston, *treasurer.*

DR. ERNEST J. HOFFMAN, research chemist, recently with W. B. Pratt, Boston, has been appointed associate chemist in the chemical engineering division, chemical and technological research, Bureau of Chemistry and Soils, to conduct research studies on farm fires with special attention to the causes of the spontaneous combustion of hay and other agricultural products.

IN the U. S. Department of Agriculture Dr. A. E. Wight has been appointed to succeed the late Dr. John A. Kiernan as chief of the tuberculosis eradication division. Dr. George W. Pope has been appointed chief of the field inspection division, succeeding Dr. A. W. Miller, who is now chief of the packers and stockyards division. Dr. Miller succeeds John T. Caine, resigned. Dr. W. E. Cotton has been designated as acting superintendent of the bureau's experiment station at Bethesda, Md., succeeding the late Dr. E. C. Schroeder. The administrative changes have also provided for two new positions, designated as associate chief of the bureau and assistant chief. Dr. U. G. Houck, who continues as chief of the division of hog-cholera control, also holds the title of associate chief of bureau. Dr. A. W. Miller, besides being chief of the packers and stockyards division, is assistant chief of bureau.

THE sixth Harvey lecture, by E. J. London, director of physiology at the University of Leningrad, on "Experimental Fistulae of Blood Vessels," which

was announced for April 13, has been postponed until April 20 at 8:30 o'clock.

DR. J. J. R. MACLEOD, of the University of Toronto, lecturer for 1928 under the Louis Clark Vanuxem foundation at Princeton University, gave four lectures during March under the general title "The Fuel Used for Energy Production in Animals." These recent investigations in animal metabolism are to be published in book form.

DR. DAVID RIESMAN, of the University of Pennsylvania, gave an illustrated lecture at the annual meeting of the George Washington University Medical Society in Washington, March 17, on "Man before the Dawn of History."

EDWARD W. BERRY, professor of paleontology at the Johns Hopkins University, delivered an address entitled "Idols of the Market Place" before the Yale University geology club on March 29.

DR. W. H. EMMONS, professor of geology at the University of Minnesota and state geologist of Minnesota, delivered a lecture on March 22 to the students in geology at the University of Toronto, on "The Relation of Metalliferous Lodes to Igneous Intrusions."

DR. BORIS SOKOLOSS, a former deputy in the North Russian government, who has paid especial attention to cancer research, is in this country and will work in the Rockefeller Institute.

PROFESSOR MARGARET C. FERGUSON, of the department of botany at Wellesley College, is giving a series of six lectures, under the auspices of the Ropes memorial organization of Salem. The lectures center around the subject of plants and advancing civilization and are being given in Salem at the Ropes memorial building on consecutive Wednesday afternoons in March and April.

LIEUTENANT-COLONEL CHAS. F. CRAIG, of the Army Medical School, Washington, D. C., lectured to the research club of the department of medical zoology of the Johns Hopkins School of Hygiene and Public Health on March 30 on the subject of "Complement Fixation in Amoebiasis."

GERRIT S. MILLER, JR., curator of the division of mammals in the U. S. National Museum, has arrived in Sanchez, Dominican Republic, where he will spend the next few months investigating the caves of the region for bones of the extinct fauna of the island. A. J. Poole was expected to return to the museum early in April, having spent about four months in the same kind of work in Haiti, on the opposite side of the island.

PROFESSOR YOSHINORI TAKEZAKI, in charge of the plant-breeding work of the department of agriculture, Kyoto Imperial University, Japan, is visiting the United States.

RICHARD S. SCHONLAND, of the forest service of the Union of South Africa, has been in the United States for a year studying forest conditions and practices and the organization of forest experiment stations.

PROFESSOR JIRI V. DANES, of Charles University, Prague, who is in this country as an official lecturer under the auspices of the International Institute of Education, lecturing at various colleges and universities, is taking the opportunity to study some of the karst areas of the United States.

DR. ALFONS JACOB, lecturer in psychiatry at Hamburg, has been invited by the Brazilian government to undertake the establishment of an institute for the study of the anatomy of the brain at Rio de Janeiro, and to deliver a course of lectures on nervous and mental diseases from May to July.

BEGINNING May 14 and continuing until June 24, E. O. Essig will conduct a University of California course in field entomology in the Yosemite National Park, with headquarters at the new Yosemite Park Museum. From July 1 to August 1 of the same season he will be at his permanent summer camp at Echo Lake, in the High Sierras, 7,500 feet altitude, eleven miles from Lake Tahoe. Entomologists visiting California are invited to call on Professor Essig at either of the above places and he will be very glad to assist them in the various types of entomological work in those regions.

DR. R. A. MILLIKAN, director of the Norman Bridge laboratory of physics of the California Institute of Technology, gave one of the Proctor Foundation lectures at the Brooklyn Institute of Arts and Sciences on April 5. His subject will be "Recent Advances in Spectroscopy."

DR. WILLIS R. WHITNEY, director of research of the General Electric Company, has been selected by Midwest Association of Sigma Xi to deliver its inaugural addresses on April 12, in Chicago. The midwest association is an affiliation of the three university chapters of the national honorary research fraternity in Cook County, Illinois, with about five hundred other members in the Chicago district engaged in professional work outside university circles. The address will be preceded by a banquet.

DR. ARTHUR D. LITTLE, president of Arthur D. Little, Inc., delivered the Aldred lecture at the Massachusetts Institute of Technology, March 23, on "Chemical Industry."

PROFESSOR WILLIAM L. BRAGG, of the University of

Manchester, addressed the physics colloquium at Harvard University, March 26, on "A Direct Determination of Zero Point Energy."

PROFESSOR A. S. EDDINGTON, F.R.S., Plumian professor of astronomy at the University of Cambridge, has accepted an invitation to deliver the Adamson memorial lecture. His subject will be "Philosophical Tendencies in Modern Science," and the lecture will be delivered in the university on May 4.

E. W. MAUNDER, who was for many years superintendent of the solar department at Greenwich Observatory, died on March 21 at the age of seventy-six years.

SIR DAVID FERRIER, the distinguished English neurologist, died on March 19 in his eighty-sixth year.

THE diamond anniversary of the founding of the California Academy of Sciences was celebrated in the building of the academy on April 4. After a formal reception, brief addresses were given by the Honorable William H. Crocker, president of the board of trustees; Dr. C. E. Grunsky, president of the academy, and Dr. Barton Warren Evermann, director of the museum.

THE annual meeting of the Federation of the American Societies for Experimental Biology will take place at Ann Arbor, Michigan, on April 12, 13 and 14. The federation includes the American Physiological Society, the Society of Biological Chemistry, the Society of Pharmacology and Experimental Therapeutics and the Society of Experimental Pathology. The annual Conference of Biological Chemists will be held in connection with this meeting; the main topic for discussion this year is the proposed changes in the biochemical curriculum in the medical schools.

THE Society of Experimental Biology and Medicine during the past few years has established branch sections in several institutions in the United States. Recently the question has been raised as to whether a branch should be established in Rochester, Minn. There are at present sixteen members of the national organization in Rochester. At a meeting of this group it was decided to form a local society and to hold meetings at which the results of experimental work could be presented and discussed. Final decision in regard to affiliation with the national organization was postponed until after the organization of the local group has been perfected.

THE National Colloid Symposium has accepted the invitation of the University of Toronto to hold the Sixth Symposium there on June 14, 15 and 16. The guest of honor at this meeting will be Sir William Hardy, of Cambridge, England. Arrangements have been made for an exhibition of experimental methods in colloidal work; a large hall has been secured adjoining the building in which the symposium will be held, and space will be offered free for exhibits accepted by the local committee. It is thought that in this way workers in colloids may be enabled to bring to the attention of their colleagues many details of experimental arrangement and technique which are necessarily crowded out of the limited program of papers; it is hoped that those presenting papers at the symposium will accept this opportunity of displaying the apparatus used in their work and that others with novel types of apparatus will take advantage of the opportunity to exhibit them.

ONE of the features of the second session of the Institute of Chemistry of the American Chemical Society, to be held at Northwestern University, Evanston, Ill., from July 23 to August 18, will be a series of lectures, specialized in character and treating thoroughly a variety of topics of interest alike to academic and industrial men. Those taking part include Harry N. Holmes, head of the department of chemistry of Oberlin College, who will take for his subject "Colloids." B. S. Hopkins, of the University of Illinois, will lecture on "Modern Inorganic Chemistry." Arthur I. Kendall, of the Washington University School of Medicine at St. Louis, will lecture on "The Chemistry of Bacteria." Victor K. La Mer, of Columbia University, will present a series of lectures on "Modern Physical Chemistry." W. T. Read, now of the Texas Technological College and formerly at Yale University, will discuss "Modern Industrial Chemistry." G. L. Wendt, at present dean of chemistry and physics at Pennsylvania State College and director of the Battelle Memorial Institute, will lecture on "Industrial Research." F. C. Whitmore, the director of the second session of the Institute of Chemistry and professor of chemistry at Northwestern University, will lecture on the subject of "Modern Organic Chemistry."

THE former section of history of chemistry of the American Chemical Society is now a division, and members who wish to be enrolled in this division are invited to send their names to Dr. Tenney L. Davis, Massachusetts Institute of Technology.

THE first convention of Sigma Pi Sigma, national physics fraternity, will be held at Davidson College, Davidson, N. C., on April 10 and 11. Dr. Marsh W. White, of Pennsylvania State College, will be the principal speaker.

AT a meeting of the chemistry research club of Columbia University on March 29, papers were presented on "The Hydrolysis of Sucrose by In-

vertase," by Maxwell Schubert, and "Activity Coefficients of High Valence Ions and a Simple Method of Handling the General Solution of the Debye Theory of Electrolytes," by Victor K. La Mer.

THE National Park Service announces plans for the fourth summer school for the training of naturalists, nature guides and teachers of natural history, to be opened on June 25 in the Yosemite National Park. The work was inaugurated by the California Fish and Game Commission and is also participated in by the Yosemite Natural History Association. The school has a faculty of seven, under the leadership of Ansel F. Hall, chief naturalist.

THE Whiting Corporation, Harvey, Ill., has established in the Mellon Institute of Industrial Research an industrial fellowship, whose holder, Dr. Edward E. Marbaker, will conduct research on cast iron. The results of these investigations will be published for the general benefit of the foundry industry.

JEFFERSON MEDICAL COLLEGE has given notice in Orphans Court of an intention to claim a $67,000 trust fund left by Dr. James Ewing Mears to Harvard University for the study of eugenics, which that university rejected a year ago.

PROFESSOR R. P. COWLES has presented to the department of zoology of the Johns Hopkins University his collection of gastropod shells, marine and terrestrial. These shells were collected at the Marine Biological Station in the Philippine Islands, located at Puerta Galera, on the Island of Mindoro.

THE United Engineering Society has received a bequest of $1,000 through the will of the late Oberlin Smith, president of The American Society of Mechanical Engineers in 1890.

WITH the aid of students now in residence, the Brooks research fund, designed to aid students in botany and zoology at the Johns Hopkins University, has now passed the ten thousand dollar mark.

ADDITIONAL funds have been received by the Fitzwilliam Museum, of the University of Cambridge, completing the fund of £100,000 required for the proposed extension.

THE widow of the late Professor Emanuel Kayser, paleontologist and geologist, of Munich, desires to sell his library. It has about 11,000 pamphlets and 500 to 600 books. Those interested should address his daughter, Frau Cilly Engelmann, Weissenburgstrasse 3, Marburg, Germany.

THE Comitè National Belge de l'Eclairage has accepted the task entrusted to it by the International Commission on Lighting of establishing in Brussels an international research department on the distribution of electrical illumination with the view of drawing up a series of standards.

THE British National Institute of Industrial Psychology, London, which was founded seven years ago for the application of the human sciences to the everyday needs of industry, has received an anonymous gift of £4,000 towards the cost of new premises.

THE Martin Johnson African Expedition Corporation, through its president, Daniel E. Pomeroy, has presented to the American Museum of Natural History 200,000 feet of film taken by Mr. and Mrs. Martin Johnson during their four years in Africa. The museum has placed the 8,000 feet of this film, which made up the motion picture "Simba," in a vacuum sealed container, which will not be opened for fifty years, when it is believed that a majority of the animals now constituting the wild life of Africa will have disappeared.

UNIVERSITY AND EDUCATIONAL NOTES

PRINCETON UNIVERSITY has received a quarter of a million dollars in pledges toward the alumni fund to raise teachers' salaries as the result of the first month of the canvassing for a $2,000,000 endowment.

BEQUESTS of the late James Ward Packard include $20,000 to Lehigh University. After Mrs. Packard's death one third of the residuary estate will go to the university.

THE University of Buffalo has received a gift of $100,000 from Mr. Darwin D. Martin to establish the Martin professorship of mathematics.

GEORGETOWN UNIVERSITY has received $250,000 from Mr. and Mrs. Thomas J. Maloney, of Waldwick, N. J., for the Chemo-Medical Research Institute to be built on the university grounds.

DR. ARTHUR L. TATUM, of the University of Chicago, has been appointed professor of pharmacology at the University of Wisconsin, in association with Dr. A. S. Loevenhart. He will assume his duties at Madison on September 15.

PROFESSOR H. B. WALKER, head of the department of agricultural engineering at Kansas State Agricultural College, has resigned to accept a similar position with the agricultural branch of the University of California at Davis.

AT Yale University, Professor William R. Longley, professor of mathematics, has been appointed to the Colgate professorship in place of Professor Luquiens. The following assistant professors were promoted to the rank of associate professors: Dr. Oystein Ore,

mathematics; Dr. Stuart R. Brinkley, chemistry; Roscoe H. Suttie, civil engineering; Archer E. Knowlton, electrical engineering; Everett O. Waters, mechanical engineering; Arthur Phillips, metallurgy, and Dr. Blair Saxton, chemistry. Instructors who were promoted to assistant professorships are: Dr. Robert De W. Coghill, chemistry; Lauren E. Seeley, mechanical engineering; Dr. Richard F. Flint, geology; Dr. Lucius T. Moore, mathematics; Dr. Jesse W. Beams, physics. Dr. Dirk Brouwer has been appointed research assistant in mathematical astronomy.

AMONG those who will give courses at the summer quarter of Stanford University are: Dr. Harry Clark, associate member of the Rockefeller Institute, in physics; Dr. Alfred Errera, of the University of Brussels, and Dr. Carl Einar Hille, of Princeton University, in mathematics; Dr. J. J. Runner, assistant professor at the University of Iowa, in geology, and Professor Edward A. Bott, of the University of Toronto, in psychology.

DR. ROBERT ROBINSON, professor of organic chemistry at the University of Manchester, has been appointed to the chair of organic chemistry in University College, London.

DR. GEORGES FONTÉS has been appointed professor of biological chemistry at Strasbourg, and Dr. Arnt Kohlrausch, of Greifswald, professor of physiology at Tübingen.

DISCUSSION AND CORRESPONDENCE

A PERIODIC CLASSIFICATION OF THE HARDNESS AND MELTING-POINTS OF THE ELEMENTS

IT is possible to classify the elements according to hardness and melting-point, and this classification fits with considerable precision into an eighteen-period table based on spectroscopic similarities.

The table (see Fig. 1) represents the elements arranged according to atomic number, with those of similar spectra in columns. The columns under H and He represent the first stage in the building-up of the electron structures of the atom, that of building on the two "s" electrons; the six following columns add the "p" electrons, while the long group from Sc to Zn all contain elements to which the "d" electrons are being added. Thus at the end of each column we have the complete shells; the "s" shells, under He, the "p" shells under the rare gases, and the "d" shell under Zn. Lanthanum and the 14 Rare Earths come under Y. These represent the "f" electron being built on.

Let us first consider the melting-points. If we examine the table, we find some striking characteristics. In the first place, all the elements with high-melting points are at one end of the table, while those with low melting points are at the other. Then let us examine the columns. For each column under Sc, Ti, V, Cr, Mn, Fe, Co, Ni, the melting-points increase down the column. Under Cu all are nearly equal. Under Zn, B, C, there are minima at Hg, Ga, Sn, respectively. The N column has a maximum at As. The melting-points under O, F, Ne, all increase down the column. It is interesting to note that the permanent gases conform to this periodicity as well as the non-gases. The alkali metals decrease in melting-point down the column. Under Be there is a minimum at Mg. The only discrepancy is Ti, whose melting-point is slightly above what we should expect.

Another interesting characteristic is that the whole first long period row (Sc–Cu) have similar melting-points, falling off slightly at either end. The same is true for the next two rows.

Turning to the subject of hardness, we find that this in general varies as the height of the melting-point. It is of course difficult to obtain accurate values for absolute hardness but considering some recently obtained by A. Mallock,[1] and others, we note that all the hard metals are bunched, as are the soft ones. The maxima and minima are in the same places, and the runs follow the same sequences as do the melting-points. The discrepancies are, V, and Pd; but Mallock claims the V was not obtainable pure in the proper form for the test, and Rydberg[2] claims that

[1] A. Mallock, *Nature*, Feb. 19, 1927, p. 276.

[2] Rydberg, *Zeits. f. Physikalische Chemie*, 33 (1900) 353–9.

																H	He	
																Li	Be	
											B	C	N	O	F	Ne	Na	Mg
											Al	Si	P	S	Cl	A	K	Ca
	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	Rb	Sr
	Y	Zr	Cb	Mo	Ma	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	Cs	Ba
La and 14)		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	85	Rn	87	Ra
Rare Earths)		Th	Ux	U	93													

FIG. 1. Table of the elements, arranged with regard to spectroscopic similarities, in order of atomic number. Inspection will show how hardness and melting-point fit in, the harder ones being at the middle of the (left) long period.

Pd and Fe are about equally hard, as we should expect. That C, B, Be, and others are hard, while Cs, Rb and P are soft is well known. We see, therefore, that hardness is quite well expressible in the same curve as melting-point.

We have, then, an interesting correlation. The spectroscopic properties and the melting-points and hardnesses are expressible in the same table. And as the agreements on the whole are so good, holding not only for metals, but for non-metals and gases, we might venture to predict the characteristics of those whose melting-points and hardnesses have not yet been determined. Thus we suggest that 85 (Eka-Iodine) will melt at about 250° C. and be fairly soft, and that 87 (Eka-Caesium) will melt at about 18° C., and be very soft. Number 93 will be hard and of high melting-point, coming as it will below Re. We also suggest that the value of Masurium, assumed in the International Critical Tables to be 2,300° C., will be nearer 2,500° C.

It is evident from the foregoing that there exists a relation between the electronic configuration and the melting-point and hardness. We notice that the atoms with the complete shells have the lowest melting-point. Those with a partial shell, such as W, Re, and Os, where about half the "d" shell is on, have high melting-points, and are hard. The "irregular" atoms, whose electron shell structure, and in particular, whose outer shell is incomplete, thus have greater mutual attraction, and less yielding to deformation of the solid configuration than those with complete shells. The deformation of a substance by shear and compression forces (the method of testing hardness) is thus quite similar in its fundamental effect on the atoms of the substance to the deformation in melting; atoms sliding on atoms more readily if the atoms have complete shells. There is evidently less stray field holding these complete shells together. Hence in the central part of each period we find the harder elements and the soft ones at the ends. This, according to our interpretation of the table, means that the elements increase in hardness as more electrons are built on, attain a maximum somewhere before half the shell is completed, and fall off in hardness as the shell nears completion to a minimum at the complete shell.

S. A. KORFF

PRINCETON UNIVERSITY

FURTHER EVIDENCE CONCERNING MAN'S ANTIQUITY AT FREDERICK, OKLAHOMA

IN SCIENCE of February 10 appears a note by Dr. Leslie Spier, of the University of Oklahoma, questioning certain phases of the evidence bearing on man's antiquity at Frederick, Oklahoma. The geological age of the deposits, their nature and occurrence, are well established and not questioned. He states however, "The artifacts themselves are equivocal," and questions their occurrence and contemporaneity with the fossils; and their Pleistocene age.

In relation to their authenticity as human implements, according to his own statement therein, *i.e.*, "— I have not seen the originals," he is hardly in a position to speak with authority on the matter, especially in the face of the fact that no one who *has* seen them has questioned their authenticity as human artifacts.

Dr. Spier particularly questions the grinding stones to which we have referred as "metates," in describing them. It would appear that his objection may be based on our choice of name for them, or upon a misunderstanding as to how such grinding stones were used by nomadic, non-agricultural Indians,—uses to which his published remarks would indicate a lack of familiarity. In regard to this matter, the writer has in his personal collection a number of such grinding stones from the region near the Black Hills, South Dakota, which were used by the Sioux Indians of that region when the writer first knew them as a boy. These Indians did not raise or use any sort of grain or cereal, and were a nomadic, hunting race; yet they did use, until they secured better implements and food from the white man, "metates," or grinding stones, of the type found at Frederick, Oklahoma. They used these at semi-permanent camp sites for crushing and breaking up dried fruits, (such as cherries and plums), dried meat, "Indian 'turnips,'" and other dried roots and plants which they dried and cured for winter use, much of which dried exceedingly hard.

It is entirely probable that in this, as in many other instances, need and a similar environment have caused different peoples at widely separated times and places to do similar things independently and reach similar results; and it certainly is not, in itself, and unsupported, evidence of racial homogeneity. It can equally well be, and probably is, another case of parallelism. I have personally seen these stones so used many times, and now have some of their dried foods as well as grinding implements in my private collection. Therefore, the argument that such could not have great antiquity, because, "All Americanists are agreed that cereal raising is not one of the original constituents of Indian culture" is without value. Beyond this, what "Americanist," or anyone else, for that matter, is in a position at this time to speak with authority of the habits or customs of any race

of men in early Pleistocene times in America—beyond that offered by the limited evidence of this Frederick discovery, and one or two others.

Dr. Spier's reference to determination of age by the type of artifacts characteristic of certain cultural stages in Europe is also assuming something, when applied to North America, that no one yet knows. It is well to bear in mind that the well known stages of Europe are *terminals,* and may have diverged widely from what was going on in America in Pleistocene times. Granting man's presence here, it is not safe to draw *a priori* conclusions on circumstantial inference, until they are supported by clean-cut evidence in North America. Our archeologists have studied, almost wholly, the cultures of comparatively recent times on this continent, and have not, in conjunction with geologists, (as has been done in Europe), worked out the sequence of Pleistocene events in this country, in relation to mankind. Until this is done, evidence based on type of workmanship in stone found here, is mere guesswork, outside of comparatively modern cultures. There is crying need for much to be done in this direction at this time, in America. The conviction in the minds of some men that no such evidence would ever be found in America, has, beyond doubt, gone far to retard such research.

As to the authenticity of these grinding stones, as such: Professor E. B. Renaud, internationally known archeologist, now of the University of Denver, is the last specialist who has examined these artifacts, and has just measured and examined them critically with the writer, since Dr. Spier's article appeared. He, like all others who have seen them, gives them his unqualified indorsement as human artifacts. We find all three artifacts figured in the original accounts to bear unmistakable evidence of human workmanship. The edges show distinctly the coarse chipping done in shaping them with "hammer stones" or other implements, on all sides. All three show clearly evidences of abrasion and wear *in the center on both sides.* The larger grinding stone has had the most wear, and is abraded in an oblong basin to a depth of twenty-three millimeters on one side, by about three hundred and eighty millimeters long; and eight millimeters deep on the reverse side, in a depression two hundred and seventy millimeters long. Distinct striæ from abrasion, "pecking marks," and other usual evidences of such use and wear, with which any one who knows such stones is familiar, are clear cut and abundant. There is no mistake. They are real, humanly formed artifacts, as may be observed by any one who cares to examine them, and, not merely "selected as metates because of their close resemblance to such forms."

As to their being contemporaneous with the fossil mammals of that deposit, (which Dr. O. P. Hay and the writer are describing elsewhere, in joint papers), we have rather definite, unpublished evidence to offer.

During a recent visit to Frederick, (December, 1927), the writer took occasion to examine much more carefully the upper bed in that section, (Bed C. of our published diagrams)[1] and secured evidence that we had overlooked in the early examinations. This upper bed, three to five feet in thickness, with columnar structures when dry, is composed largely of fine clays and silts, the shrinkage of which is responsible for such structure, as it dehydrates. But mingled through this bed irregularly are considerable quantities of granitic gravels, some very coarse. Being situated on a hilltop, it is obvious that this gravel must have been washed there from higher levels before it *was* a hilltop, and while the surrounding surface levels were at least as high or higher than this hill is to-day. As the hill is about one hundred feet above local valleys, and in the light of correlated evidence on this erosion, previously published, it becomes obvious and certain that Bed C, as well as the underlying cross-bedded sands and gravels, is of Pleistocene age. Only in its very surface, and a few inches down, are recent deposits possible, save by intrusive burial of some sort. Now, Bed C is very dark red in color, heavily permeated with stains of hematite, so that all included gravels and anything it may contain are stained a deep, muddy red, so dark that even photographs of the deposit sharply outline it from the underlying Bed B. Obviously any implement which came from these surface deposits, or any such wash-filled basin as Dr. Spier imagines as possible or even from any stage of the Pleistocene Bed C, would certainly bear unmistakable evidence of its origin from this stain.

Re-examining with this in mind, with Dr. Renaud, we note that these grinding stones are *not* so stained, but bear only a slight, much lighter colored stain, such as characterizes Beds A and B in local lenses. Beyond this, in the rough surfaces of the stone, and adhering to their surfaces in many places, are still many areas of matrix, still cemented to the stones and unmistakably undisturbed, as found by Mr. Holloman. This matrix is that most characteristic of Bed B, but also occurs in the upper part of Bed A, where Mr. Holloman reported finding the implements; and, by no chance could it pertain to a level as high as Bed C.

I believe that no further authentication of the accuracy of Mr. Holloman's statement as to their

[1] *Natural History,* Vol. XXVII, No. 3, 1927.

actual occurrence in these Pleistocene beds is necessary. Mr. Holloman is now keenly alive to the importance of these discoveries, as he was not when we first talked to him; and, as he had previously found and discarded other similar implements before we saw him, he is confident of eventually finding more, as commercial quarrying continues in this deposit. When it is found, he told the writer that he would do all in his power to protect it *in situ*, and wire for authorities to come and view it for themselves. Consequently, as the quarry is now being actively developed, further discoveries are to be expected in this great deposit.

HAROLD J. COOK

COLORADO MUSEUM OF NATURAL HISTORY

THE GEOLOGY OF SONORA

WHILE making a study of the sedimentary rocks in the Cananea Mining District, Cananea, Sonora, Mexico, I found some fossils which Dr. G. H. Girty, of the U. S. Geological Survey, has determined as belonging to the Carboniferous Age. The limestone in which the fossils occur was formerly considered to be Cambrian.[1]

Dr. Girty says: "The fossils from Cananea accompanying the letter of February 19 from Dr. Graham John Mitchell are, without much question, of Carboniferous Age, but to assign them within the Carboniferous System with any degree of certainty is impossible. The specimens, all very fragmentary, include cup corals (*Triplophyllum*? and *Lithostrotion*?), a strophomenoid (*Schuchertella* or *Derbya*), a *Spirifer* (apparently of the *Rockymontanus* group), and *Hustedia*."

GRAHAM JOHN MITCHELL

THREATENED EXTINCTION OF THE RUFFED GROUSE

ACCORDING to a recent report of the Department of Fisheries and Game, the ruffed grouse is facing extinction in the state of Massachusetts. Only a few of these magnificent upland game birds have been seen within the past year; and why this is so is not fully known, though it is believed that they have succumbed to a periodic visit of the partridge sickness. The winter and spring of 1926–27 were not sufficiently severe so as to decimate any large numbers of them, nor was the toll of the hunting season unusually large. But with the present mild winter, and a good breeding season, it is hoped that this once common game bird will be able to make sufficient numbers to withstand successfully the depredations of its natural enemies during the coming year. And with a closed season next fall, which the legislature is at present considering, to assist in their fight, it is believed that within a year or two they will be back on a fairly sound basis. It is to be regretted should this bird have to be added to the already long list of vanishing species.

BIRGER R. HEADSTROM

MEDFORD HILLSIDE, MASSACHUSETTS

[1] *Ec. Geology*, vol. 5, No. 4, June, 1910, page 317.

WHAT IS A NAME?

SINCE Dr. Holland's recent fatherly note (SCIENCE, Feb. 10, p. 161) the differences between us seem reduced to one (I will not quarrel over the word "binomial"):

Is Limnas ferruginea Chrysippus (Hübner) as good a name as Papilio Danaus Festivus Chrysippus (Linnaeus) or Sphinx Adscita Phegea, which every one accepts?

The idea will be expanded in *Entomological News*.

WM. T. M. FORBES

CORNELL UNIVERSITY

SCIENTIFIC BOOKS

A treatise on the British Freshwater Algae in which are included all the pigmented Protophyta hitherto found in British freshwaters, by the late G. S. West, M. A., D.Sc., F. L. S., A. R. C. S., professor of botany at the University of Birmingham. New and Revised Edition in great part rewritten by F. E. FRITSCH, Professor of Botany in the University of London. (Cambridge, The University Press) xviii+ 534 pp., 207 figs. in text. Price 21 shillings. 1927.

THE first edition of this highly valued treatise, issued nearly twenty-five years ago, has been so long out of print that this new and up-to-date edition will be doubly welcome. Since the microscopic freshwater flora is so cosmopolitan in its distribution this handbook will serve others than British investigators. It will also be useful to zoologists as well as to botanists, since the reviser has included all pigmented or colored flagellates within the Algae. The first fifty pages are given to generalities, such as the ecology, distribution, collection, cultivation, structure, cytology and reproductive processes of the Algae. The author is inclined to minimize the significance of the polymorphism of the unicellular Algae brought about in cultures because of the lack of correlation of such results with the same species in their natural environments. Certain normal well established instances of polymorphic life cycles of both unicellular and multicellular stages do not justify sweeping general conclusions at present as to the extent of comparable polymorphism elsewhere among the Algae.

A very useful list of the algae of typical associations is given for various habitats such as ponds and ditches, rainpools, lakes, mountain tarns, flowing waters, bogs, salt marshes, wet rocks, damp ground, subterranean soil and tree trunks.

The greater part of the book is concerned with a systematic discussion of the eleven classes of freshwater Algae as follows: Isokontae, Heterokontae, Chrysophyceae, Bacillariales (Diatomales,) Cryptophyceae, Dinophyceae (Peridinieae,) Chloromonadales, Euglenineae, Rhodophyceae, Myxophyceae (Cyanophyceae.)

The author accepts the view of Luther, Borzi, Bohlin and others that the various classes of algae have had their origin from unicellular flagellates with similar pigments and storage products. He accordingly includes such flagellates in these respective algal classes. Zoologists will be interested in the bearings of these segregations on current classifications by protozoologists. The desirability of some sort of protistological organization of this common ground of the two biological disciplines and jurisdictions is rapidly becoming more evident.

The author uses the term Dinophyceae in lieu of Dinoflagellata. This is to be regretted, since the latter has been so widely used for many years, and the scope of the former strictly speaking can not be legitimately extended to include the Gymnodiniaceae and Peridiniaceae. The citation of Woloszynska's observations of polygonal plates on *Gymnodinium* without criticism might lead the reader to accept the idea that the structures thus detected really belonged to a true *Gymnodinium* instead of to a young or recently exuviated member of some armored genus such as *Peridinium*.

The illustrations are mainly old, but well selected and well executed. One might wish there were more of them, especially in a systematic treatise of this sort, but the author had to choose between the Scylla of condensation and the Charybdis of expense. A brief list of important works and a full index add to the usefulness of this excellent revision of a highly valued handbook.

CHARLES A. KOFOID

Gewebezüchtung. Handbuch der Biologie der Gewebezellen in Vitro. 2 vermehrete Auflage. By ALBERT FISCHER. München: Rudolf Müller und Steinicke, 1927. 508 pages, and 151 illustrations.

THIS volume is a German edition of Albert Fischer's "Tissue Culture," which was published in 1925 by Levin and Munksgaard, Copenhagen. Fischer may well be regarded as the most successful research worker in all Europe in this particular field. The excellent introduction was written by Dr. Alexis Carrel, the eminent authority on the subject of tissue cultivation. The book is really an entirely new edition of the first, fully revised and enlarged. A thorough description of the technique of tissue culture renders the book especially valuable for investigators in this field, which is rapidly becoming more and more important. In addition, the value of his work is greatly enhanced by the comprehensive and critical presentation of the very significant results and numerous new formulations of biological questions brought out by this method.

An historical review is followed by chapters on: (1) Media employed in the cultivation of tissues *in vitro;* (2) technique covering the preparation of culture media and the various substances now used; cover-glass preparations; measurement of the rate of growth; flask culture method; application of the microdissection method; photography and microscopic examination of cultures; (3) pure strains of cells; (4) tissue culture as a physiological method; (5) morphology; (6) tissue culture as a pathological method, and lastly, a most important chapter on the behavior of tumor cells *in vitro*. An excellent bibliography is appended.

The author's success in the cultivation of tumor cells is outstanding. He devised a technique whereby strains of malignant cells are made to grow permanently outside of the organism. The tumor cells do not lose their malignancy during their life *in vitro*. Even after many passages, a culture when transplanted to an animal gives rise to a tumor with metastases. This is true not only of Rous sarcoma, but also of different epithelial tumors which have been cultivated; for example, the carcinomata of mice.

The results obtained by the method of tissue culture have widened our scientific outlook and have correspondingly increased our knowledge of cell physiology, and Albert Fischer is to be highly congratulated upon his book on this subject.

ALBERT H. EBELING
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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE VISUAL METHOD FOR DEMONSTRATING THE DIFFUSION OF OXYGEN THROUGH RUBBER AND VARIOUS OTHER SUBSTANCES

IN experimental work in which small quantities of oxygen are to be measured, rubber connections must be avoided because of the error introduced by the

diffusion of oxygen through rubber. Coating such connections with paraffine, as is sometimes done, is of negligible value, as is shown by the following experiments. A simple visual demonstration of the diffusion of oxygen may be made by using luminous bacteria as an indicator. It has been shown by Harvey and Morrison (1923)[1] that these bacteria will give a just perceptible glow when the partial pressure of oxygen is only .0053 mm Hg.

A test tube is completely filled with a dilute suspension of luminous bacteria and closed with a rubber dam, care being taken to see that no air bubbles are included. The suspension will glow brightly until practically all the oxygen has been consumed. The light then disappears except in contact with the membrane and for a short distance from it. If a suspension of the proper concentration has been chosen a gradient of brightness is obtained, most brilliant in contact with the membrane and fading out toward the other end of the tube. The critical worker who desires a control may use for the purpose a glass-stoppered tube or graduate of the same diameter as the experimental tube. This becomes completely dark.

If it is desired to form a rough estimate of the relative amounts of oxygen diffusing through various substances, this may be done by comparing the length of the luminescent columns, provided that all the tubes are filled with a suspension of the same concentration and that convection currents are reduced to a minimum. In a recent experiment, the results shown in the table were obtained. The thermostat was kept at $24.6 \pm .3°$ C., and top and bottom temperatures of the double walled box in which the apparatus was set up were recorded by Beckmann thermometers. The maximum difference between top and bottom was .054° C., and the average difference for the time of the experiment was .024° C. It is not believed that this difference was sufficient to set up disturbing convection currents.

It will be apparent from a glance at the table that for detecting the presence of minute quantities of oxygen very dilute suspensions are best, while for estimating relative quantities, suspensions somewhat more concentrated must be used. There is then established a mobile equilibrium, oxygen diffusing in at a definite rate, and being consumed at a definite rate, the ratio of the two rates determining the length of the luminescent column.

The long-continued luminescence under kerosene and xylol is surprising, as both of these are cytolyzing agents. On pouring off the oils at the end of the sixth hour, those under these two substances were found to be somewhat injured, as they did not exhibit full brilliance. Small quantities of all the substances used were shaken with bacterial suspensions, and all

[1] Harvey, E. Newton, and Morrison, Thos. F., "The Minimum Concentration of Oxygen for Luminescence by Luminous Bacteria," *J. G. P.*, *6*, 13, 1923.

	Suspension 1		Suspension 2
	2 hours	6 hours	3 hours
Open control	10 cm.	10 cm.	10 cm.
Glass stoppered control	(Dark in 45 min.)		(Dark in 3 hours)
Wet collodion	4 cm.	4 cm.	10 cm.
Kerosene	4 cm.	3 cm. (dim)	10 cm. (dim)
Paraffined cork	3 cm.	3 cm.	10 cm.
Paraffine oil	3 cm.	3 cm.	10 cm.
Paraffine (52°)	3 cm.	3 cm.	10 cm.
White vaseline	3 cm.	3 cm.	10 cm.
Amber vaseline	2 cm.	2 cm.	10 cm.
Wet parchment	2 cm.	2 cm.	10 cm.
Paraffined parchment	2 cm.	2 cm.	10 cm.
Olive oil	1.5 cm.	1.5 cm. (dim)	10 cm. (dim)
Thin lubricating oil	1.5 cm.	1.5 cm.	10 cm.
Xylol	1.5 cm.	1.5 cm. (dim)	10 cm. (dim)
Rubber dam	.5 cm.	.5 cm.	4 cm.
Paraffined rubber stopper	Trace	0	trace
Medium motor oil	0	0	.5 cm.
DeKhotinsky on rubber dam	0	0	0
DeKhotinsky on cork	0	0	0
Dried collodion on linen	0	0	trace

Length of luminescent columns of bacteria under various oils, etc. The tubes used contained 10 cm. of the bacterial suspension.

were found harmless except olive oil, kerosene and xylol, each of which caused a considerable diminution of brilliance. Evidently the slight solubility and slow diffusion downward of these substances saved the bacteria from cytolyzing effects.

The impermeability or very slight permeability of viscous motor oil to oxygen is in agreement with the finding of Kruse (1926)[2] that alkaline pyrogallate solutions under medium motor oils were not perceptibly oxidized after eight weeks, while those covered with kerosene and mineral oil were oxidized 30 per cent. and less than 5 per cent., respectively. This difference Kruse ascribes to the greater viscosity of the motor oils.

It will be noted that of the liquids used the medium motor oil is by far the best for exclusion of oxygen. Heavy rubber stoppers and thick tubing, if time is allowed for diffusion out of the oxygen dissolved in the surface, will introduce only small errors, the diffusion of oxygen through rubber as thick as 1 cm. being slight.

SAMUEL E. HILL

PHYSIOLOGICAL LABORATORY,
PRINCETON UNIVERSITY

SPECIAL ARTICLES

THE PRODUCTION OF MUTATIONS AND REARRANGEMENTS OF GENES BY X-RAYS

MUTATIONS and rearrangements of genes have been produced by Muller by subjecting *Drosophila melanogaster* to the action of X-rays.[1] Similar experiments have since been performed by the writer; and these, while not so extensive, are in entire agreement with those of Muller. As a result of X-ray treatment, there have been obtained mutations producing visible and lethal effects, as well as genetic modifications of the frequency of crossing over, and attachments between genes of different chromosomes.

Males of *Drosophila melanogaster* were exposed to X-rays in dosages corresponding approximately to those designated by Muller as T4 and T2, the former being about twice the latter. The treated males and untreated brothers used as controls were mated to untreated females. The fertility of the irradiated males and of their offspring was reduced, the stronger treatment being the more effective in each case. As has been suggested by Muller, sterility might be produced in the treated males by mutations resulting in dominant lethal genes, and it might be produced in the offspring by mutations resulting in dominant genes for sterility.

The experiment was designed primarily to test the effect of the treatment on the X-chromosome. In order that the treated and control X-chromosomes might be recognized in subsequent generations, the males were mated to females that differed from them in certain sex-linked genes. Since every daughter received a treated or control X, any change in this chromosome would be inherited by half her sons and would be detected if it produced a visible or lethal effect.

Nine of the thirty-seven F_1 females in the T4 series and ten of the forty-seven F_1 females in the T2 series were found to have inherited altered X-chromosomes from their fathers. No changes in the X were observed in the fifty-six F_1 females of the controls. (Only the fertile females are included in the reckoning.) In X's of the T4 series there were three mutant genes (one dominant, two recessive) producing visible effects, and six lethals. In X's of the T2 series there were two genes (both recessive) producing visible effects, and eight lethals. Of the non-lethal mutant genes, three recessives are allelomorphs of genes already known (deltex, furrowed, uneven); the others seem to be changes in hitherto unknown loci.

The experiment was not designed to detect mutations in the autosomes; and such changes resulting in recessive genes would, for several reasons, have escaped discovery. (One autosomal recessive was found in an F_2 culture in the control series, but it must have been present in heterozygous form in either the male or the female of the P_1 generation.) New autosomal dominants, however, could be recognized; and three were found, all in the T2 series. One of these (an eye color—the only dominant mutant eye color known in *D. melanogaster*) arose in a treated male; the two others (probably allelomorphs of Star and Hairless, respectively) may have originated in either the males or the females of the P_1 generation.

In the offspring of the treated flies there were found six translocations in which genes of the second chromosome behave as if attached to the X; that is, they are inherited in sex-linked fashion. In at least some of these cases, genes along the entire length of the second chromosome behave in this way. The point of attachment in the X differs in different cases; whether or not the point of attachment in the second chromosome differs is not known. The results would

[2] Kruse, T. K., "The Relative Efficiency of Several Oils for the Exclusion of Oxygen," *J. Phar. and Exp. Ther.*, *27*, No. 3, April, 1926.

[1] Muller, H. J., "Artificial Transmutation of the Gene," SCIENCE, Vol. 66, pp. 84–87 (1927); "The Problem of Genic Modification," *Proc. Fifth Int. Congress of Genetics* (in press); "The Effects of X Radiation on Genes and Chromosomes," abstracts in *Anat. Record*, Vol. 37, p. 174, and SCIENCE, Vol. 67, p. 82.

seem at first sight to imply attachments between entire chromosomes; but they might also be produced by the attachment to one chromosome of a piece of another, provided that individuals receiving more or less than the normal complement of genes did not survive. Tests are being made to decide between these alternatives and to discover (if fragmentation is involved) which chromosome is broken. Three of the translocations occurred in the T4 series (where such changes could have been detected in seventeen cases), and three in the T2 series (where they could have been detected in forty-three cases). None were observed in the controls, although here they could have been detected in fifty-five cases. It seems probable that in the irradiated flies there occurred in addition to the translocations observed others involving genes not followed in the experiment. (No genes of the third or fourth chromosome were followed.)

Eight cases of genetic reduction of crossing over in the X-chromosome were observed; some prevent crossing over almost entirely, others affect only part of the chromosome. Five were in the T4 series and three in the T2 series; but this does not represent the total frequency of such modifications, since they could have been recognized in only twenty-two cases in the former and thirteen in the latter. In the controls no such changes would have been detected; but it is very unlikely that they occurred, for in all the *Drosophila* work in which X-rays have not been used only five genetic modifications affecting crossing over in the X-chromosome have been found. In the present experiment one of the modifiers is associated with no other effect, one is associated with a non-lethal mutant gene, the others with lethals or translocations.

The dominant eye-color gene behaves as if it were continually mutating in both germ and somatic cells. It is not yet certain, however, that the behavior is to be ascribed to mutation.

Apart from this, the new genes (they have all, with the exception of one lethal in the T2 series, been followed through several generations) seem to behave like ordinary mutant genes. It is possible that some of the lethals are not due to point-mutations. Six of them are associated with crossover modifiers or with translocations; and this suggests that the same disturbance may be responsible for all the effects in each case. There is also a possibility that some of the other lethals are due to translocations involving genes not followed in the experiment. Nevertheless, it is probable that at least some of the lethals are due to changes in single genes. One of the lethals apparently crosses over from the translocated genes with which it is associated. And all the non-lethal genes behave like point-mutations—some of them are, in fact, allelomorphic to, if not identical with, genes produced by ordinary mutations. The nature of the crossover modifiers has not yet been ascertained.

A comparison of the mutation rates is best made on the basis of the changes in the X-chromosomes. If we include the visible mutants and the lethals, about one X-chromosome in four mutated in the T4 series, about one in five in the T2 series, and none in the controls. The figures suggest that a greater effect was produced by the stronger treatment (and the same is true of the translocations). But the numbers are not large enough to decide whether the effect is proportional to the dosage or to some function of it. Moreover, it may be that the effect of the stronger treatment is relatively underestimated. For there was more sterility in the T4 series; and if the frequency of mutation was correlated with sterility (quite apart from whether sterility was produced by mutations), then the individuals in which the greatest number of mutations occurred were the very ones that could not be tested.

But if the results do not show precisely how the mutation rate varies with the strength of the treatment, they demonstrate the effectiveness of the treatment itself. There were eight (possibly ten) mutant genes producing visible effects and fourteen lethals in the eighty-four treated individuals, and none in the fifty-six controls. The results are being subjected to further analysis; but the work has gone far enough to show that, as in the experiments of Muller, genes can be modified and rearranged as a result of treatment with X-rays.

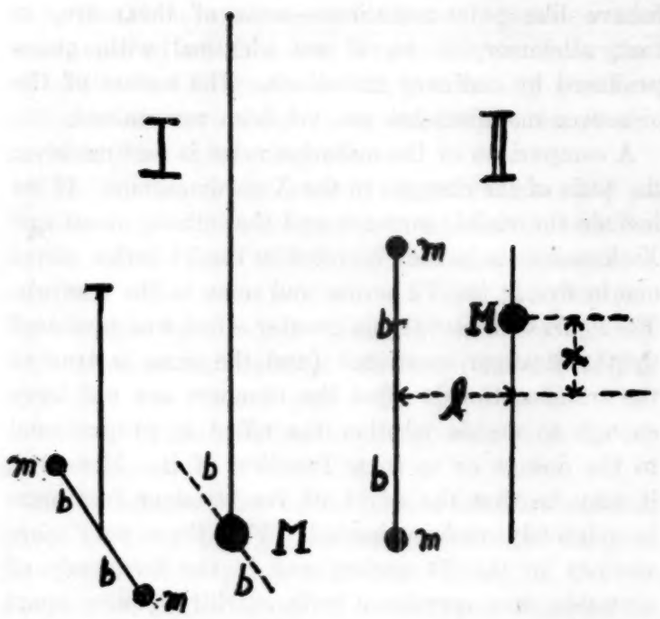
The writer desires to thank Dr. L. A. Milkman for his cooperation in administering the X-ray treatments.

ALEXANDER WEINSTEIN

COLUMBIA UNIVERSITY

A DETERMINATION OF THE NEWTONIAN CONSTANT OF GRAVITATION BY A STUDY OF THE VIBRATIONS OF A TORSION PENDULUM

CONSIDER the result of suspending an enclosed torsion pendulum, supposed for simplicity to consist only of two massive particles m, m at distances b from the axis of suspension, in the vicinity of the spherical bob of a common pendulum; the latter being symmetrically placed with respect to the torsion pendulum and executing vibrations of amplitude b in a plane parallel to m, m. If the two periods are nearly equal, the alternate gravitational attractions of the large mass upon the two particles m, m will cause the torsion pendulum to vibrate about its axis of suspension. Besides the torsional oscillations there will be forced



pendular vibrations; but these may be neglected. Let I be the moment of inertia of the torsion pendulum; k the couple due to damping for unit angular velocity; and μ the moment of torsion of the suspension. Let the displacement $\varkappa$ of M at time t be $\varkappa = b \sin \varrho t$. Set

$$2a = \frac{k}{I}; \quad n^2 = \frac{\mu}{I}.$$

Then the differential equation of motion of the torsion pendulum is

$$(1). \quad \frac{d^2\vartheta}{dt^2} + 2a\frac{d\vartheta}{dt} + n^2\vartheta = \frac{GMmb}{I l^3}\left[\frac{1}{\left\{1+\frac{1}{l^2}(b-\varkappa)^2\right\}^{3/2}} - \frac{1}{\left\{1+\frac{1}{l^2}(b+\varkappa)^2\right\}^{3/2}}\right]$$

where G is the constant of gravitation. The right hand member of (1) may be replaced by the first term of its Fourier sine series (suggested by E. P. Adams), which it very nearly equals:

$$(2) \quad \frac{GbMm}{I l^2}\left(1 - \frac{1}{\left(1+\frac{4b^2}{l^2}\right)^{3/2}}\right)\sin \varrho t = B \sin \varrho t.$$

The solution of (1) which satisfies the initial conditions is

$$(3) \quad \vartheta = \frac{B}{\left\{(n'^2-\varrho^2)^2 + a^2(a^2+2n'^2+2\varrho^2)\right\}^{1/2}}\left\{e^{-at}\frac{\varrho}{n'}\sin(n't+\varepsilon') + \sin(\varrho t - \varepsilon)\right\}$$

where $n'^2 = n^2 - a^2$; $\quad \tan \varepsilon = \frac{2a\varrho}{n'^2 - \varrho^2 + a^2}$;

and $\tan \varepsilon' = \frac{2an'}{\varrho^2 - n'^2 + a^2}$.

The period of free torsional oscillation $T = \frac{2\pi}{n'}$; and $aT = \log \eta$, the logarithmic decrement of the torsion pendulum for complete swings.

Suppose that we make the periods equal, so that $n' = \varrho$: Then

$$(4) \quad \vartheta = \frac{B}{a(4\varrho^2+a^2)^{1/2}}\left\{e^{-at}\cos(\varrho t + \varepsilon') + \sin(\varrho t - \varepsilon)\right\}$$

where $\varepsilon = \varepsilon' = \tan^{-1}\frac{2\varrho}{a} = \frac{\pi}{2}$ nearly.

As $t \to \infty$, the amplitude approaches a maximum $\vartheta_m = \frac{B}{2\varrho a}$ nearly. Substituting for B its value from (2), $\varrho = \frac{2\pi}{T}$, $a = \frac{1}{T}\log \eta$, $l = 2mb^2$, and solving for G, we find:

$$(5) \quad G = \frac{8\pi b l^2 \log \eta}{MT^2\left(1 - \frac{1}{\left(1+\frac{4b^2}{l^2}\right)^{3/2}}\right)}\vartheta_m.$$

In the writer's experiments the torsion pendulum was adjusted until its period was 7.4485 sec. That of the common pendulum was 7.4508 sec. M was the bob of a Foucault pendulum, and weighed 5.5×10^5 grams. In one particular experiment b was 38.5 cm., l was 29.7 cm., and log η was found by an auxiliary experiment to be .00603. The only effect of convection currents in the torsion pendulum box could have been to hasten the approach of the amplitude to ϑ_m (which might otherwise be asymptotically approached). After about fifty minutes, ϑ_m was reached; and by a set of readings by mirror and scale was found to be 3.8×10^{-4} radians. By (5) G was found to be 6.75×10^{-8} C.G.S. units. The average of the results of several such experiments was

$$G = 6.6_5 \times 10^{-8} \text{ C.G.S. units.}$$

(True value $G = 6.6576 \times 10^{-8}$)[1]

Though not as accurate as the refined Cavendish method, this experiment is a simple one to perform. The writer's apparatus was assembled in about six hours' time, since he was aided by the presence of a large Foucault pendulum. In case no great accuracy is desired, the method presents the advantage that it is free from errors due to non-periodic convection currents, so troublesome in the Cavendish form of the experiment.

T. E. STERN

PALMER PHYSICAL LABORATORY,
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[1] C. V. Boys, Phil. Trans. A, 1895, part 1.

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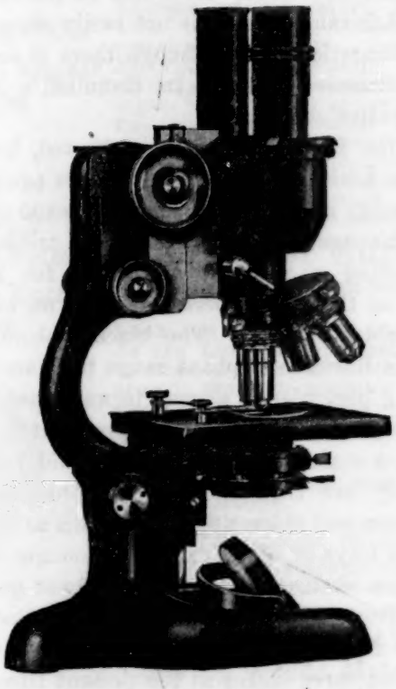

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SCIENCE NEWS

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OXYGEN ON MARS AS AN INDICATION OF LIFE

THE presence of oxygen gas in the atmosphere of Mars is the best evidence to date of life on that planet, according to the opinion of Dr. Henry Norris Russell, of Princeton University, who spoke recently at the University of California at Los Angeles.

The concentration of oxygen about Mars is only about fifteen per cent. of that over the earth. This was recently shown by measuring the wave-length of certain radiation passing through the moving atmosphere of the planet. So dilute an atmosphere would not support life in animals of the earthly type. There is no very good reason, however, why an entirely different animal evolution should not produce creatures whose venous blood or other bodily fluid could absorb oxygen at low air pressure. Nevertheless, as a matter of simple logic oxygen still does not prove the presence of animal life.

In the vegetable realm oxygen tells a more convincing story. Dr. Russell points out from the chemical viewpoint that free oxygen gas is utterly out of place in the advanced stages of a dead world. In particular, the ferrous iron minerals, present in vast quantities in the various planets, by the laws of the chemist should long ago have absorbed all oxygen gas in sight. In such chemical action the minerals are normally converted into the ferric iron of common red soils. It is only the reverse chemistry of a growing plant which could possibly restore a supply of the active gas.

Extensive gray-green bands on the planet Mars—sometimes called "canals"—are thought by Dr. Russell to consist of vegetation. The extreme distance of the planet, however, renders evidence of animal life so far impossible of detection.

The very existence of a planet such as the earth with so favorable a combination of physical and chemical conditions is regarded by the astronomer as an extremely rare accident. Accordingly there are likely very few inhabited worlds in proportion to the total number of heavenly bodies in existence. Nearly all are either too hot, too cold, too small to hold an atmosphere by force of gravitation, too dry, or have the wrong kind of atmosphere. Moreover, it is equally unlikely that any great number of inhabited worlds would happen to develop during the period of time in which we live.

BELGIAN ELEPHANT FARMS

PLOWING by elephant in the Belgian Congo has proved fourteen times less costly than plowing by tractor. Since maintenance of the great beasts, including food, two attendants each, medication and depreciation, works out to about twenty-five cents a day and a trained elephant brings about $2,400, at the present value of the franc, the government elephant farms at Bas-Uele and Haut-Uele in the Kongo district are expected to be soon on a self-supporting basis.

On account of the havoc brought upon horses and cattle by the tsetse fly, the government began experimenting with the training of wild elephants as far back as 1902. Indian mahouts and domesticated Burmese elephants were imported but both soon succumbed to the climate. The ferocious African elephant is not easily transformed into a gentle domestic servant, though there is some evidence that the famous elephants in Hannibal's legions were from his native continent.

Before the Burmese mahouts departed, however, they taught the African natives some of the age-old Burmese elephant songs and a few apt pupils picked up the art of elephant management. Certain fierce tribes found elephant hunting a pleasant substitute for killing their neighbors so that the experiment went on after the war with redoubled interest. The black mahouts were soon singing the Burmese elephant songs to Niam-Niam tunes, but the big pachyderms seemed to understand.

Only baby elephants, from approximately two to ten years old, are singled out from the wild herds for capture. They are trained under the tutelage of skilled elephant men and older elephants known as "moniteurs," wise in the ways of breaking in the younger ones of their kind. Some idea of the rate of elephant growth can be gathered from the case of one elephant that has grown from four feet two inches when he was captured in 1902 to eight feet three inches at the present time.

It is estimated that one elephant will plow two and a half acres in two days and is an otherwise valuable asset in pulling stumps, piling timber and such arduous tasks, necessary in bringing a new country under cultivation.

DISEASE OF THE GROUSE

THE grouse disease that has made the partridge literally a rare bird in sections of the northeast, where his drumming was once as familiar as the robin's call, is proving a difficult problem for science to unravel.

Under the direction of Dr. A. A. Allen, of Cornell University, research has been carried on for three years with the object of locating the cause and possible cure of the scourge. Progress has been hampered by the fact that ruffed grouse are delicate and high-strung birds to handle in the laboratory. Some of the difficulties can be appreciated from the fairly typical results obtained by one game preserve officer, who succeeded in raising only 50 birds from 394 eggs laid in captivity.

Attempts made to identify the germ of the malady responsible for the large losses throughout the northern states and Canada have not yet succeeded, though a vast amount of useful information has been collected concerning the parasites that infect the birds and certain fungus diseases that affect the lungs. It has been found that one parasite produces changes in the blood that bring about the deposit of waste products in the feathers, causing patches of them to turn black.

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The tick that transmits tularemia, the rapidly spreading disease of wild rabbits and man, is also suspected of infecting grouse. Dr. R. R. Parker, of the Spotted Fever Laboratory at Hamilton, Montana, has found the tick on grouse but has been handicapped in further research on the problem from lack of funds with which to secure live birds for experiment. One species of grouse has definitely been infected artificially in the laboratory, but whether this dreaded disease is actually prevalent among birds in the field is not yet known.

RICKETS IN BIRDS

FEATHERS may be still another source of the much-discussed antirachitic vitamin D. Hawks and owls raised by Dr. William Rowan, of the University of Alberta, Canada, in captivity and fed only on "livers and lights" from the butcher shop developed rickets and in many cases died before reaching maturity. His experiments are reported in *Nature*. Two young owls, however, that had been fed mice and sparrows almost exclusively, were not affected. This suggested the addition of chicken heads with feathers and an occasional sparrow to the menu of the rest of the survivors. Thereafter rickets ceased to give trouble.

The preen gland of the domestic fowl, Dr. Rowan points out, is known to be a rich source of cholesterol, one of the parent substances of vitamin D, a condition that may apply to feather oil. As further evidence for his suggestion, he cited the case of a merlin under his observation several years ago that fed her offspring on birds that were plucked before they were brought to the eyrie. Only occasionally did she bring home a victim with the feathers still on, from which she fed the young birds mouthfuls of feathers only. Her offspring apparently objected to the "dose" because it had to be thrust well down their throats before it would go down.

"Possibly," said Dr. Rowan, "it is true that there is nothing new under the sun, and we may here be witnessing a crude method of administering the antirachitic vitamin D that has, no doubt, been in practice for countless centuries."

THE DOG'S WORLD

THE average dog owner could write an enthusiastic book about his pet's intelligence and keenness. But scientists have only begun to penetrate into the dog's world, to find out carefully and exactly how much a dog sees and understands.

Experiments so far made indicate that the average dog has far more faulty vision that most dog-lovers suppose, according to a survey of what is known about dog psychology made in *The Quarterly Journal of Biology* by Dr. C. J. Warden and L. H. Warner, psychologists of Columbia University.

Laboratory experiments in Russia and other countries have led most psychologists to believe that the dog has little or no ability to see colors. A puppy that seems to know red from green may be responding to a difference in the brightness of the two colored objects, or some other clue that his human friends overlook. A dog's vision for still objects appears to be decidedly inferior to that of a man, but he is keenly sensitive to moving objects.

A dog's sense of smell appears to be far superior to that of a man. A German shepherd dog, for example, was able in every instance to pick out a small piece of pine wood that had been handled by her keeper, even when the piece of wood was placed with as many as twenty other pieces that he had never touched. Two seconds' contact between the keeper's hand and the object was sufficient to insure the dog's identifying the keeper with the object.

On the other hand, police dogs were tested in Germany by giving them the glove of a person and telling them to pick out the owner from a row of men. The dogs all failed on this test and on a number of other tests intended to prove their usefulness in police work. As a result of the tests the use of dogs in criminal detection was forbidden by the Prussian Government. It is not clear whether the dogs really "understood" what was wanted of them in these tests.

Whether dogs recognize words as a human being does, or whether they respond to sounds, or merely to tones and inflexions of the voice, is not agreed upon by experimenters. In tests with the thoroughbred German shepherd dog, "Fellow," recently made by Dr. Warden and Mr. Warner, the dog responded to 400 words used in various commands given by his master Jacob Herbert, of Detroit. In some cases, Mr. Herbert gave the commands from an adjoining room with the door closed, thus showing that the dog did not depend on watching his master's face or gestures for clues. Taking commands through a closed door was new to "Fellow," and the voice was muffled, but he made a good record though not a perfect one.

One of the chief reasons why scientific men disagree on the dog's capacities is that all sizes and sorts of dogs have been used in experiments, from highly bred bull terriers to an assortment of mongrels. The authors suggest that a representative breed of dog should be settled upon for systematic study.

THE KENTUCKY MOUNTAINEERS

A LITTLE over a century ago, the mountaineers of eastern Kentucky were probably slightly superior to the average American in intelligence. To-day, these disappearing American highlanders rank considerably lower than average.

To find the cause for this striking decline in mentality, Dr. Nathaniel D. M. Hirsch, of Duke University, has visited three counties of the mountain country and has tested almost 2,000 young highlanders.

According to Dr. Hirsch, environment is responsible for only about 25 per cent. of the sub-average mentality; heredity is the cause of 75 per cent. For a hundred years migrations have played a large part in lowering the intelligence level. Long ago, when game and fish became rare in eastern Kentucky, the people who had settled in the mountains were faced by the problem of trying to farm the steep hillsides, or of moving. A migration of the restless and foresighted took place about 1820 to 1840.

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Folia Anatomica Japonica (Tokio, Japan)
The Journal of Parasitology (Urbana, Ill.)
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Two more waves of migration struck the mountain region, one about the time of the Civil War and again in 1880. Now, since 1903, there has been a fourth migration, which has probably not yet reached its height, carrying away chiefly the more energetic, ambitious and intelligent groups.

Dr. Hirsch concludes that very close intermarriage of the depleted stock that has remained in the mountains is another cause for the falling level of intelligence. The outlook, however, is good. The gifted sons and daughters of the mountains, who have moved to more desirable surroundings are contributing their pure blood and sturdy character to American life in a wider field. "The nation is bettered by their spread," says Dr. Hirsch. "The communities to which they move are biologically and morally enriched."

The mountains that they left are being rapidly developed industrially for the hidden resources of oil, gas, soft coal, mica, kaolin. More changes have taken place there in a few years than in a whole century preceding. The unique civilization of isolated pure-blooded highlanders will soon be lost by the intermingling of mountain families with the Italian and Hungarian laborers that are coming in to dig in the mines, run the railroads and work in lumber camps.

ITEMS

BUTTERFLY breeders, who have built up a respectable little business in Germany as well as in the United States, have their work simplified for them by a simple trick described by Julius Stephan, a German naturalist. Many butterflies have the habit of emerging from their cocoons at night, so that breeders have had to sit up with their charges until all hours in order to prevent them from fluttering about their cages and damaging their delicate wings. Herr Stephan avoids this nocturnal labor by artificially hastening nightfall. At two or three in the afternoon he transfers the cocoons to a dark, cool place, and the insects soon begin to display their normal night-reaction. By seven o'clock all that are due to emerge that day will have put in their appearance.

THE latest available figures of the U. S. Public Health Service show that there are 250 more cases of smallpox in the last reported week in March than there were in the corresponding week of last year. In spite of the fact, however, that smallpox is more prevalent this year in the country at large, it has just been reported to the American Medical Association that not a single case of the disease has been contracted in the public schools of St. Louis, Mo., for thirty-three years. Systematic vaccination with subsequent inspection and reinspection of vaccinations on the part of the city division of health and the hygiene department of the public schools are considered the agents that have made possible this remarkable record.

ULTRA-VIOLET light can be used to take photographs to reveal alterations in documents, according to a report of Professor Carlo Bonacini to the *Rivista Fotografica Italiana*. He has found that writing on a paper which had been erased by chemical means, and was entirely invisible to the eye, had altered the fibers of the paper, a fact which was shown by the ultra-violet photograph. Professor Bonacini has also confirmed previous reports that if writing is done in ink of the ordinary kind, and the paper is placed in contact with an ordinary photographic plate or film for a time, the plate loses its sensitivity where it touches the writing. Then, if it is briefly exposed to the light, and developed, the writing appears transparent on a gray background. He has found that this works even if the writing has been bleached by chemicals, so that the method offers another way of detecting altered checks or other documents.

A DIET high in protein or meat increases the activity of laboratory rats but makes them easily frightened. These are some of the results of an attempt to find the effect of food on the temper made by Professor Emil Abderhalden, of the University of Halle, who has been making determinations of the psychological behavior of rats fed on different diets. One series of rats was fed on a diet that was rich in protein and poor in carbohydrates, while a control series of similar rats was fed on a more usual diet, with abundance of carbohydrates. The experiment was continued for a considerable time, and observations were made of rats' dispositions while fed on the prescribed food. It was found that the variation of the diet had a striking effect on the behavior. The rats which received little carbohydrate and a great deal of protein showed distinctly abnormal characteristics. They were much more active and were more resistant to the ill effects of alcohol. Together with these more or less desirable changes was a decidedly undesirable one, namely increased susceptibility to fright.

THE use of charcoal for producer-gas as a propellant for motor vehicles is being seriously considered in Great Britain. The Forests Products Research Laboratory has already conducted preliminary experiments on various methods of preparing charcoal for this purpose. So far it has investigated two French types of portable kilns, and also the more ordinary type of bee-hive kiln. Arrangements have been made with the Fuel Research Station to carry out tests on the charcoal prepared from various species of timber, and to determine its value for producer-gas.

SOLID bubbles of selenium, the element that transmits electricity when light shines on it, though at other times it offers great resistance to an electric current, can be blown with the aid of a glass tube, according to a report in *Nature*, by Charles E. S. Phillips. The selenium is melted and then when the tube is dipped into it, withdrawn and blown through, a rather sausage-shaped bubble can be blown. A curious effect reported is that when two bubbles, even twenty-four hours old, are brought into contact, they come violently together and can not again be separated. The method is said to be a convenient one of getting flakes of selenium for experimental purposes.